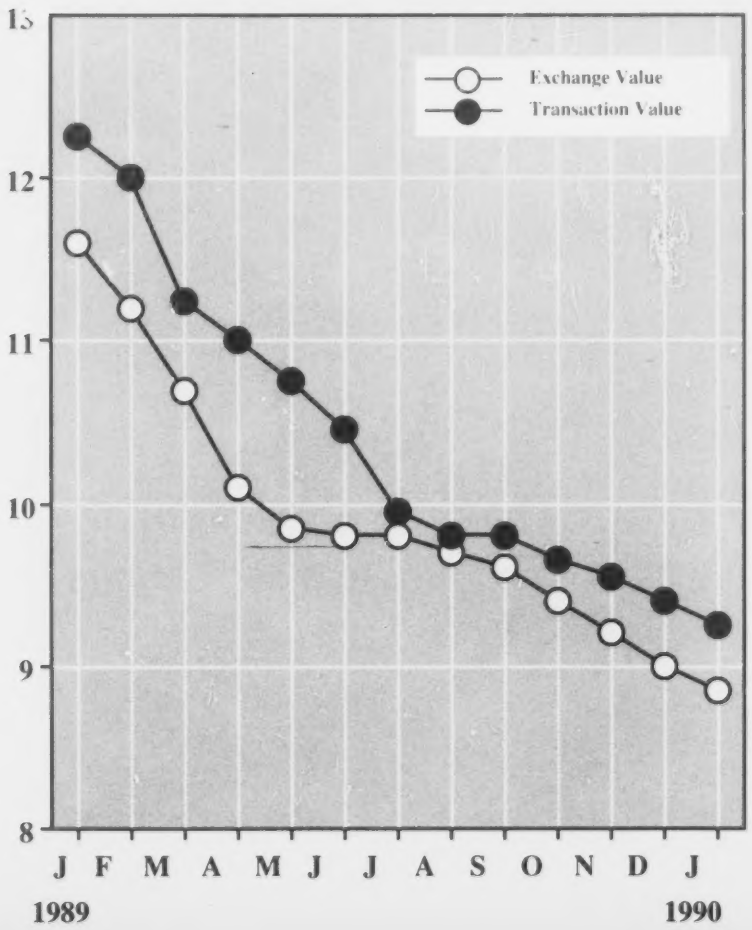
B6500-1 A

NUEXCO

Monthly Report

February 1990 Number 258

Swedish Nuclear Phaseout Under Review	13
Soviet Uranium Supply Capability	20
Projected Uranium Requirements of Developing Countries	29



NUEXCO

International Headquarters

Three Park Central, Suite 900
1515 Arapahoe Street
Denver, Colorado 80202 USA

Telephone: (303) 899-4500
Telecopy: (303) 899-4555
Telex: 450202 (NUEXCO)

Service Locations

DENVER, COLORADO, USA

Three Park Central, Suite 900
1515 Arapahoe Street
Denver, Colorado 80202
Telephone: (303) 899-4500
Telefax: (303) 899-4555
Telex: 450202 (NUEXCO)

WASHINGTON, D.C., USA

11 Dupont Circle, Suite 505
Washington, D.C. 20036
Telephone: (202) 328-9250
Telefax: (202) 328-6699
Telex: 248253 (NUEXCO DC)

ZURICH, SWITZERLAND

Leberngasse 15
4603 Olten
Switzerland
Telephone: (41-62) 320032
Telefax: (41-62) 321450
Telex: 981600 (NUXCH)

SAN FRANCISCO, CALIFORNIA, USA

Building 1, Suite 105
3000 Sand Hill Road
Menlo Park, California 94025
Telephone: (415) 854-1510
Telefax: (415) 854-2115
Telex: 470674 (NUEXCO SF)

HONG KONG

1403 Shui On Centre
6-8 Harbour Road, Wanchai
Hong Kong
Telephone: (852) 865-1418
Telefax: (852) 865-2721
Telex: 67206 (CNITC)

GENEVA, SWITZERLAND

13 chemin du Levant
01210 Ferney-Voltaire
France
Telephone: (33-50) 428035
Telefax: (33-50) 428526
Telex: 385288 (NUEXCO F)

Service Entities

NUEXCO (Headquarters)	Oren L. Benton, Chief Executive Officer
NUEXCO International Corporation	Charles H. Peterson, President
NUEXCO Trading Corporation	Earl E. Hoellen, President
NUEXCO Exchange AG	Hans W. Vogt, Managing Director
NUEXCO Information Services Company	Charles H. Peterson, President
NUEXCO Asia, Limited	Gerald L. Murdock, Managing Director
NUEXCO Transportation & Services Corp. ("NuTranS")	Robert L. Bovey, President

NOTICE

This Report is prepared especially for Subscribers and is furnished to them for their use only. Except for internal use by Subscribers, no part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of NUEXCO. Neither this Report, nor copies of any portion thereof, may be lent, sold or given to non-Subscribers.

The information in this Report was gathered from sources NUEXCO believes to be accurate. However, NUEXCO makes no warranty, express or implied, and assumes no legal liability or responsibility for the accuracy, completeness or usefulness of any information contained herein.

© 1990 NUEXCO Services Ltd.

ISSN 0742-4582

NUEXCO

MESSAGE TO THE READERS AND CUSTOMERS OF NUEXCO

**A Follow-up Message from Oren L. Benton,
Owner and Chairman of NUEXCO,
on NUEXCO's Publication of the NUEXCO Exchange Value
(Included as an insert to NUEXCO Report No. 258)**

In my *Message to the Readers and Customers of NUEXCO* published in the June 1989 Monthly Report, I commented on NUEXCO's activities of publishing the NUEXCO Exchange Value (NEV) and trading as a principal in nuclear fuel. I affirmed therein my intention to have NUEXCO continue its activities as a trading, brokerage, consulting, and information services company (including publication of its judgment of spot market prices) because I believed such to be in not only NUEXCO's, but the nuclear fuel industry's best interest. I also stated in my earlier Message that I had directed the formation of a group to examine and discuss the processes, procedures, and results bearing upon the integrity of the NEV and its publication by NUEXCO.

A Task Force for the above purpose was established at the end of July. Membership included J.R. Wolcott as chairman (formerly Chairman of NUEXCO and with General Electric for over 20 years prior thereto), H.E. Bose (independent legal counsel with over 20 years' experience in nuclear fuel contracting, representing General Electric and later NUEXCO), O.J.C. Runnalls (Immediate Past Chairman of the Canadian Nuclear Association and formerly with Atomic Energy of Canada, Ltd., Uranium Canada, Ltd., as well as previous Senior Advisor to the Department of Energy, Mines and Resources in Ottawa), and J.C.C. Stewart (Chairman of the British Nuclear Forum and formerly Managing Director, Production Group, for the United Kingdom Atomic Energy Authority). Messrs. Wolcott, Runnalls, and Stewart are members of NUEXCO's International Advisory Committee.

This Task Force intentionally comprised persons of (1) senior stature, whose integrity was above question; (2) substantial industry experience, who could appreciate both the importance and the sensitivity of the matter; (3) varied nationalities, to avoid any appearance of national bias; and (4) varied professional backgrounds, to bring different perspectives to bear. The desire for objectivity had to be balanced with a need to recognize the proprietary nature of the subject.

The Task Force members extensively interviewed NUEXCO employees, observed the NEV processes in action (in some cases on an undisclosed basis), reviewed results, talked with certain customers, and took other actions in their investigations as they chose. The Task Force had no restrictions on its focus or the extent of its access to data, personnel, or actions of NUEXCO.

© NUEXCO 1990

NUEXCO

This Task Force has presented to me its extensive written report, and its detailed recommendations will be given serious consideration. The basic conclusions of the Task Force are quoted as follows:

> " 1. The quality of the NUEXCO Exchange Value is as sound as one can reasonably expect. We found no evidence that past or current judgments produced bias in favor of NUEXCO. The process provides for inputs from many individuals, located in numerous, separate offices, and participants concerned with different aspects of different transactions. Judgment dominated by any person, or special interest group, would not be practical in the present diversified, decentralized system.
>
> 2. The importance of a consistently-used, well-administered process is such that increased use of written policies, procedures, and records is recommended to ensure that operations are consistently carried out in accordance with Company intent and in a verifiable manner.
>
> 3. The Task Force questions whether continued NEV publication serves NUEXCO's interest. Both NUEXCO and the industry served have changed substantially since publication began 20 years ago. We recommend (a) a reexamination of purpose in the context of current and future needs, and (b) reevaluation of the advantages and disadvantages as compared to possible alternatives."

I am satisfied that the findings concerning the soundness of the NEV are valid, and am pleased to report the Task Force conclusions. The more detailed recommendations are under review and, after further study, many will be put into practice. As a follow-up to the Task Force process, I have asked that one or more of such members periodically observe the NEV process to gain further from this experience and independence.

Recognizing that the NEV is important to both NUEXCO and those who have used it, I wish to personally assure you that so long as the NEV is published by NUEXCO, its integrity and validity will be preserved to the best of our ability. As recommended by the Task Force, the question of whether to continue publication of the NEV will be considered in a more deliberate manner. NUEXCO has no present plans to discontinue its publication of the NEV. We will appreciate any comments you may wish to make on the question of publication, or any other NEV-related matter. You may also direct any comments to any of the Task Force members in person or to the group as follows:

J.R. Wolcott, NEV Task Force
Three Park Central, Suite 1045
1515 Arapahoe Street
Denver, Colorado 80202
USA

Finally, I wish to publicly express my appreciation to the Task Force as a group and to its members individually, for their commitment to this study and their thoughtful approach to this sensitive issue.

© NUEXCO 1990

NUEXCO

Three Park Central, Suite 900
1515 Arapahoe Street
Denver, Colorado 80202

Telephone: (303) 899-4500
Telecopy: (303) 899-4555
Telex: 450202/NUEXCO DVR

1990 MARKET STUDIES

In 1990, NUEXCO will publish two market study reports, differing only in the amount of detail provided. One report will be entitled *Market Analysis and Price Trend Projections for Nuclear Fuel Materials and Services - 1990 - Summary Report*. It will be very similar in scope and content to last year's joint report with Pickard, Lowe and Garrick, Inc.

The other report will be entitled *Market Analysis and Price Trend Projections for Nuclear Fuel Materials and Services - 1990 - Extended Coverage Report*. It will contain more detail, and will be similar in depth to last year's *Uranium Market Study*.

Both reports will contain the following chapters:

1. Introduction
2. World Installed Nuclear Electric Capacity and Performance
3. World Inflation and Currency Exchange
4. World Uranium Market
5. World Conversion Market
6. World Uranium Enrichment Market
7. World LWR Fuel Fabrication Market
8. Spent Fuel Disposal

AVAILABILITY OF THE REPORTS

NUEXCO plans to have the *Extended Coverage Report* available for mailing by the end of April and the *Summary Report* by the middle of May.

For additional information about either of these reports, please contact Treva King or another NUEXCO Information Services representative at 303/899-4500.

NUEXCO

NUEXCO MONTHLY REPORT
February 1990, No. 258

* * *

EXECUTIVE SUMMARY
(All data as of January 31, 1990)

Exchange Value $8.85, down $0.15

The **Exchange Value** is **$8.85** per pound U_3O_8, down $0.15 from last month.

UF_6 Value $25.90, down $0.60

The **UF_6 Value** is **$25.90** per kg U as UF_6, down $0.60 from last month.

Uranium Sales; Supply and Demand

Six recent **natural uranium** sales are reported, involving approximately **5.1 million** pounds equivalent U_3O_8. Two of these sales involved spot or near-term delivery and met the conditions for inclusion in the Transaction Value. Active spot and near-term **uranium supply** amounts to **6.2 million** pounds U_3O_8 equivalent, and active spot and near-term **uranium demand** totals **2.5 million** pounds. This compares to the 6.0 million pound supply and 3.2 million pound demand published in the December 31, 1989 Notice to Subscribers. The spot and near-term **supply-demand ratio** is **2.5 to 1** for January 31, 1990.

Transaction Value $9.25, down $0.15

The **Transaction Value** is **$9.25** per pound U_3O_8, down $0.15 from last month. The calculation includes 17 transactions involving a total of approximately 4.0 million pounds U_3O_8 equivalent and covers a period of three months.

Loan Rate 3.5%, unchanged

The **Loan Rate** is **3.5 percent** per annum, unchanged. Two natural uranium loans are reported.

Conversion Value $1.50, down $0.15

The **Conversion Value** is **$1.50** per pound U as UF_6, down $0.15 since last month. Two transactions for conversion services are reported.

SWU Value $54, unchanged

The **SWU Value** is unchanged at **$54** per SWU. Three SWU sales are reported. Active supply declined to 665 thousand SWU, while active demand remained at 400 thousand SWU.

* * *

Swedish Nuclear Phaseout Under Review

With the January reorganization of the Swedish government and the establishment of a committee to review energy policy, the 1995 target date to begin the phaseout of nuclear power will probably be postponed.

Soviet Uranium Supply Capability

Uranium in the Soviet Union is usually recovered through by-product or co-product mining operations or by in-situ leaching. With substantial excess capacity available to produce for export, the Soviet Union is mounting a vigorous effort to expand its nuclear fuel trade with Western Europe, North America, and the Far East.

Uranium Requirements of Developing Countries

Between 1990 and 2005, developing countries will require over 173 million pounds equivalent U_3O_8 for their nuclear industries. Although these cumulative uranium requirements are expected to account for less than eight percent of total world requirements, many of these countries are expressing renewed interest in nuclear power.

© NUEXCO 1990

NUEXCO

NUEXCO MONTHLY REPORT 258 FIGURES OF THE MONTH (January, 31, 1990)	This Month (Report 258)	Last Month (Report 257)	12 Months Ago (Report 246)
Exchange Value ($US per pound U_3O_8)	8.85	9.00	11.60
UF_6 Value ($US per kg U as UF_6)	25.90	26.50	34.75
Transaction Value ($US per pound U_3O_8 equivalent)	9.25	9.40	12.25
Loan Rate (Per Annum)	3.5%	3.5%	3.5%
Conversion Value ($US per pound U as UF_6)	1.50	1.65	1.95
Near-Term Uranium Supply[1] (millions of pounds U_3O_8)	6.2	4.8	8.7
Near-Term Uranium Demand[2] (millions of pounds U_3O_8)	2.5	1.8	1.2
Near-Term Supply-Demand Ratio	2.5	2.8	7.0
Recent Uranium Sales:[3]			
Number of Transactions	6	10	15
Quantity of Material (Millions of pounds U_3O_8 equivalent)	5.1	2.0	18.4
Nuexco SWU Value: ($US per SWU)			
at 0.3 tails assay	54	54	65
US DOE SWU Prices: ($US per SWU)			
USEC	117.85[4]	118.00[5]	117.00[6]
AFC	153.00[7]	153.00[7]	153.00[7]
Requirements	157.00[7]	157.00[7]	157.00[7]
Incentive Price	90.00[8]	90.00[8]	90.00[8]
Market Value of Enriched UF_6[9]**:** ($US per kg U as UF_6)			
2.5 w/o U_{235}	279	282	350
3.0 w/o U_{235}	359	363	450
3.5 w/o U_{235}	440	446	552
4.0 w/o U_{235}	523	529	655

[1]Active inquiries to sell, for delivery within 12 months after contract signing.
[2]Active inquiries to purchase, for delivery within 12 months after contract signing.
[3]Uranium sales only; does not include loans, conversion, or SWU transactions.
[4]Effective 10/1/89 to 9/31/90.
[5]Provisional price for DOE fiscal year 1990.
[6]Effective from 10/1/87 to 9/31/89.
[7]Effective since 10/1/84.
[8]Effective since 10/1/86, for up to 30% of annual requirements.
[9]Calculated using the NUEXCO Exchange Value, Conversion Value, SWU Value and 0.30 percent tails assay.

© NUEXCO 1990

NUEXCO

NUEXCO Monthly Report

February 1990
No. 258

Managing Editor:
R. Wesley Miller

Director-Market Analysis:
Treva E. King

Editor:
France Addington-Lee

Supply Analysis:
Thomas C. Pool

Demand Analysis:
John M. Vallance

Market Analysis:
David S. Schramm

Research Services:
Carolyn B. McCants

Subscription Services:
Lori C. Mattics

Washington Focus:
Linda L. Gunter

Published by:
NUEXCO
Three Park Central, Suite 900
1515 Arapahoe Street
Denver, Colorado 80202
Telephone: (303) 899-4500
Telefax: (303) 899-4555
Telex: (303) 450202 (NUEXCO)

Other NUEXCO Publications:
Annual Review, Uranium Market Study; International Directory of Nuclear Utilities (IDNU), International Directory of Uranium Producers (IDUP)

TABLE OF CONTENTS

Pricing — 1
- NUEXCO Market Values
- Monthly Review of Natural Uranium, Conversion, Enriched Uranium, and SWU markets

Current Market Data — 4
- NUEXCO Market Values in Selected Currencies
- Recent Transactions
- Supply and Demand Tables

Recent Developments — 13
- Namibian Independence Date Set
- Swedish Nuclear Phaseout Under Review
- Washington Focus
- January Nuclear Fuel Industry Developments

Raw Materials — 20
- Soviet Uranium Supply Capability
- South Africa Quarterly Uranium Production

Analysis and Commentary — 29
- Projected Uranium Requirements of Developing Countries

Nuclear Industry Calendar — 36

Historical Market Data — 38
- Graph of Exchange Value and Transaction Value
- Historical Exchange Values
- Historical UF_6 and Transaction Values
- Historical Loan Rates, Conversion Values, and SWU Values
- Graph of World Uranium Production
- Graph of World Uranium Demand
- US Uranium Marketing Activities Statistics
- Volume and Price of Uranium Deliveries to the European Community

Government Statistics — 46
- Australia
- Canada
- South Africa
- USA

© NUEXCO 1990

NUEXCO

To Our Readers

Effective January 1, 1990, NuTranS, a nuclear transportation and services organization., was added to the CONCORD group of companies involved in the international nuclear fuel industry. Nuclear Transportation & Services Company, doing business as NuTranS, will operate out of our Washington, D.C. office. Robert L. Bovey will continue to serve as President of NuTranS.

* * *

This month Katie Bowen will be transferring from Geneva, Switzerland to Denver, Colorado, where she will be involved in uranium trading as well as other CONCORD trading and business development activities. Since joining NUEXCO's San Francisco operations in 1978, Katie helped establish a NUEXCO office in New York 1981, and has been based in Europe since opening that office in 1982.

* * *

Accompanying this month's Report is a *Message to the Readers and Customers of NUEXCO* from Oren L. Benton, owner and Chairman of NUEXCO, which follows up his *Message* published in the June 1989 Report. As mentioned in his original *Message*, Mr. Benton established a Task Force to "study steps which could be taken to further assure that the integrity of the NUEXCO Exchange Value is preserved for the benefit of the industry." Mr. Benton's current Message reports the Task Force findings with respect to the validity of the NEV.

© NUEXCO 1990

MARKET VALUES SUMMARY
January 31, 1990

Market Values	This Month (Report 258)		Active Supply* (thousands of pounds U_3O_8 equivalent)	Active Demand* (thousands of pounds U_3O_8 equivalent)
EXCHANGE VALUE [1]	$8.85/lb U_3O_8		6,200**	2,502**
UF_6 VALUE [2]	$25.90/kg U as UF_6			
LOAN RATE [3]	3.5%/annum		6,650	0
CONVERSION VALUE [4]	$1.50/lb U as UF_6		1,240	0
SWU VALUE [5] 0.3 tails assay:	$54/SWU		665	400
TRANSACTION VALUE [6]	$9.25 Per Pound U_3O_8	4.0 Million Pounds	17 Transactions	3 Months

* Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

** Includes uranium concentrates and uranium hexafluoride.

DEFINITIONS

[1] The **Exchange Value** is NUEXCO's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.

[2] The **UF_6 Value** is NUEXCO's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.

[3] The **Loan Rate** is NUEXCO's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.

[4] The **Conversion Value** is NUEXCO's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.

[5] The **SWU Value** is NUEXCO's judgment of the price at which spot and near-term transactions for significant quantities of enrichment services could be concluded as of the date indicated.

[6] The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:

a. Transactions closed within the previous three month period for which delivery is scheduled within one year of the transaction date;
b. At least ten transactions;
c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

DERIVATIONS AND COMMENTS

- All **Market Values** are based on:
  - Data from recently completed transactions.
  - Data from pending transactions.
  - Firm bids to buy or borrow, and firm offers to sell or lend.
  - Prices purchasers or rates borrowers have expressed a willingness to pay, but for which NUEXCO is not aware of firm bids to buy or borrow and prices sellers or rates lenders have expressed a willingness to accept, but for which NUEXCO is not aware of firm offers to sell or lend.
- Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not included in the determination of these **Market Values**.
- In the determination of prices, NUEXCO does not consider charges for transportation other than that customarily provided by suppliers.
- The prices of services or materials delivered under long-term contracts with primary suppliers are not considered in the determination of the listed values.
- For the **SWU Value**, NUEXCO converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight percent U^{235} and a product assay of 3.0 weight-percent U^{235}, assuming feed costs corresponding to the NUEXCO **Exchange Value** and **Conversion Value** determined as of the same date.
- In calculating the **Transaction Value**, NUEXCO does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future **Exchange Values** or any other indeterminate variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it can not currently be determined.
- The sample time for the **Transaction Value** is extended as necessary to satisfy the minima for the number of transactions and quantity of material. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

© NUEXCO 1990

NUEXCO

PRICING

NATURAL URANIUM AND SPOT CONVERSION

(All data as of January 31, 1990)

The first month of the 1990s witnessed a continuation of the trend of steadily falling prices that began in late 1987. The spot market volume for uranium included only two near-term sales totalling nearly 900 thousand pounds U_3O_8 equivalent. However, five long-term uranium sales were concluded this past month: four involved U_3O_8, and one involved UF_6.

Additionally, two conversion sales, two loans, and three enrichment sales are reported.

The **Exchange Value** continued to fall in January and reached **$8.85** per pound U_3O_8, a $0.15 drop from December 31. Relatively few spot sales occurred during January, due mostly to the lack of near term interest among buyers. Nevertheless, the downward trend continued as aggressive sellers sought to take advantage of any sales opportunities. The two spot sales totalling approximately 900 thousand pounds U_3O_8, occurred at or near the January 31, 1990 Exchange Value. They both involved utilities and intermediaries as the buyers and sellers.

Total natural uranium sales exceeded five million pounds U_3O_8 equivalent in six transactions, including the two described above. NUEXCO has been unable to verify the six million pound sale reported in the January 31 Notice to Subscribers, therefore it is not included in this month's transaction volume. The four remaining transactions involved long-term delivery and totalled more than four million pounds U_3O_8.

* * *

The **UF_6 Value** declined $0.60 to **$25.90** as supply continues to exceed demand. There has been little near-term activity lately as buyers appear to be waiting for prices to drop still further, but sellers appear equally hesitant to offer even at current levels.

Excess supply continues to exert downward price pressure in the near-term, and broad market recognition of this situation magnifies this downward pressure. One long-term sale took place involving UF_6 between an intermediary and a utility.

* * *

The **Transaction Value** dropped $0.15 to **$9.25** based on 17 qualifying sales involving 4.0 million pounds U_3O_8 equivalent over a three-month period.

* * *

Active Supply of natural uranium increased this month to **6.2 million** pounds U_3O_8 equivalent. With an **Active Demand** of **2.5 million** pounds, the **Supply/Demand Ratio** is **2.5** this month.

The supply and demand data known as of the last day of December 1989 were published in the December 31 Notice to Subscribers. The supply and demand tables published in the January Monthly Report (No. 257) reflected the subsequent reclassification of three projects from Active to Inactive.

* * *

The **Loan Rate** remains at **3.5 percent** per annum. Two loans were reported for January totalling nearly one million pounds U_3O_8 equivalent. One occurred at or near the January 31, 1990 Loan Rate. The other also took place at a rate near the January 31, 1990 Loan Rate, and involved a number of special considerations. Under certain circumstances, those special considerations could lead one to evaluate that loan at a lower rate.

* * *

© NUEXCO 1990

The **Conversion Value** declined to **$1.50** from $1.65. Two conversion sales were concluded in January at or near the January 31, 1990 Conversion Value; both involved intermediaries as sellers and utilities as buyers. Excess UF_6 supply and deconversion swaps are exerting continuing and substantial pressure on conversion prices, and the UF_6 Value remains below the sum of its component values (the Exchange Value and the Conversion Value).

* * *

The **SWU Value** remains at **$54** per SWU. Three SWU sales are reported involving two European utilities and one US utility as buyers. One sale qualified as a spot transaction, and the other two were for later delivery. These three transactions totalled approximately 300 thousand SWU.

The SWU supply declined from 730 thousand SWU last month to 665 thousand SWU but still remains plentiful compared to demand. One major US utility continues to evaluate EUP offers. In addition, two more US utilities are soliciting offers for SWU. Decisions on all three of these offers are expected in the next month. ■

© NUEXCO 1990

NUEXCO

CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb U3O8 as Concentrates			per kg U as Concentrates		
	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)
Australia (dollar)	11.58	11.33	13.17	30.10	29.44	34.25
Belgium (comm. franc)	313.27	319.60	453.48	814.44	830.89	1,179
Canada (dollar)	10.52	10.41	13.71	27.34	27.07	35.63
EEC (ecu)	7.28	7.48	10.36	18.94	19.43	26.93
Finland (markka)	35.49	36.30	49.91	92.26	94.38	129.76
France (franc)	51.14	52.08	73.60	132.96	135.40	191.35
Italy (lira)	11,204	11,390	15,823	29,128	29,610	41,137
Japan (yen)	1,286	1,296	1,499	3,343	3,370	3,898
Netherlands (guilder)	16.99	17.17	24.43	44.18	44.64	63.50
So. Africa (comm. rand)	22.55	22.83	27.86	58.62	59.34	72.42
Spain (peseta)	967.11	985.11	1,341	2,514	2,561	3,486
Sweden (krona)	54.90	55.83	73.46	142.73	145.15	190.99
Switzerland (franc)	13.31	13.90	18.42	34.60	36.13	47.88
UK (pound)	5.28	5.62	6.60	13.73	14.61	17.16
US (dollar)	8.85	9.00	11.60	23.01	23.40	30.16
West Germany (mark)	15.06	15.23	21.62	39.16	39.60	56.20

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb U3O8 as Concentrates			per kg U as Concentrates		
	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)
Australia (dollar)	12.10	11.83	13.91	31.46	30.75	36.17
Belgium (comm. franc)	327.43	333.81	478.89	851.25	867.82	1,245
Canada (dollar)	10.99	10.88	14.47	28.58	28.27	37.63
EEC (ecu)	7.61	7.81	10.94	19.79	20.30	28.44
Finland (markka)	37.09	37.92	52.71	96.43	98.58	137.04
France (franc)	53.46	54.40	77.73	138.97	141.42	202.08
Italy (lira)	11,710	11,896	16,710	30,444	30,926	43,442
Japan (yen)	1,344	1,354	1,584	3,494	3,519	4,117
Netherlands (guilder)	17.76	17.93	25.79	46.17	46.62	67.06
So. Africa (comm. rand)	23.57	23.84	29.42	61.27	61.98	76.48
Spain (peseta)	1,011	1,029	1,416	2,628	2,675	3,682
Sweden (krona)	57.38	58.31	77.58	149.18	151.60	201.69
Switzerland (franc)	13.91	14.52	19.45	36.17	37.74	50.56
UK (pound)	5.52	5.87	6.97	14.35	15.26	18.12
US (dollar)	9.25	9.40	12.25	24.05	24.44	31.85
West Germany (mark)	15.74	15.91	22.83	40.93	41.36	59.38

[1]Calculated using currency exchange rates published in *The Wall Street Journal* on the last working day of the month.

© NUEXCO 1990

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb U_3O_8 as Concentrates			per kg U as Concentrates		
	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Dec 31, 1989)	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)
Australia (dollar)	1.96	2.08	2.21	4.33	4.58	4.88
Belgium (comm. franc)	53.10	58.59	76.23	117.06	129.18	168.06
Canada (dollar)	1.78	1.91	2.30	3.93	4.21	5.08
EEC (ecu)	1.23	1.37	1.74	2.72	3.02	3.84
Finland (markka)	6.01	6.66	8.39	13.26	14.67	18.50
France (franc)	8.67	9.55	12.37	19.11	21.05	27.28
Italy (lira)	1,899	2,088	2,660	4,187	4,603	5,864
Japan (yen)	217.96	237.62	252.07	480.52	523.85	555.71
Netherlands (guilder)	2.88	3.15	4.11	6.35	6.94	9.05
So. Africa (comm. rand)	3.82	4.18	4.68	8.43	9.23	10.32
Spain (peseta)	163.92	180.60	225.43	361.37	398.16	497.00
Sweden (krona)	9.31	10.24	12.35	20.51	22.57	27.23
Switzerland (franc)	2.26	2.55	3.10	4.97	5.62	6.82
UK (pound)	.89	1.03	1.11	1.97	2.27	2.45
US (dollar)	1.50	1.65	1.95	3.31	3.64	4.30
West Germany (mark)	2.55	2.79	3.63	5.63	6.16	8.01

SWU VALUE AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	SWU Value at 0.30% Tails Assay			UF_6 Value per kg U as UF_6		
	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)	This Month (Jan 31, 1990)	Last Month (Dec 31, 1989)	12 Months Ago (Jan 31, 1989)
Australia (dollar)	70.63	67.95	73.82	33.87	33.34	39.46
Belgium (comm. franc)	1,912	1,918	2,541	916.81	941.05	1,358
Canada (dollar)	64.18	62.48	76.80	30.78	30.66	41.06
EEC (ecu)	44.45	44.85	58.04	21.31	22.01	31.02
Finland (markka)	216.54	217.83	279.69	103.85	106.89	149.52
France (franc)	312.07	312.50	412.44	149.67	153.35	220.49
Italy (lira)	68,363	68,337	88,665	32,789	33,536	47,401
Japan (yen)	7,847	7,777	8,402	3,763	3,816	4,492
Netherlands (guilder)	103.69	103.01	136.87	49.73	50.55	73.17
So. Africa (comm. rand)	137.58	136.95	156.10	65.98	67.20	83.45
Spain (peseta)	5,901	5,911	7,514	2,830	2,901	4,017
Sweden (krona)	334.99	334.99	411.65	160.66	164.39	220.07
Switzerland (franc)	81.22	83.38	103.19	38.95	40.92	55.16
UK (pound)	32.22	33.73	36.98	15.45	16.55	19.77
US (dollar)	54.00	54.00	65.00	25.90	26.50	34.75
West Germany (mark)	91.91	91.40	121.13	44.08	44.85	64.75

[1]Calculated using currency exchange rates published in *The Wall Street Journal* on the last working day of the month.

© NUEXCO 1990

NUEXCO

CURRENT MARKET DATA

RECENT TRANSACTIONS

URANIUM SALES[1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity (thousand pounds of U_3O_8 equivalent)	Approximate Price Range[2] as Percent of Current Exchange or UF_6 Value	Seller	Buyer	Remarks
4719	1990	101-300	98-102	Utility	R[3]	
4725	1993-97	1,001–3,000	See Remarks	R[3]	Utility	Base Price Escalated
4727	1993-97	1,001–3,000	See Remarks	R[3]	Utility	Base Price Escalated
4731	1990	601–1,000	98-102	Intermediary	Intermediary	
4732	1990-95	1,001-3,000	See Remarks	Intermediary	Utility	Price Related to Market
4734	1991-94	601-1,000	See Remarks	Intermediary	Utility	UF_6, Base Price Escalated

[1] Transactions listed are not limited to those in which NUEXCO was involved, but also include others of which NUEXCO is aware. NUEXCO may delay reporting some transactions in order to protect proprietary information.
[2] The range reflects five percentage points (inclusive) per grouping, centered about the middle of the range.
[3] The notation **R** means that NUEXCO either does not know, or that NUEXCO has restricted that information to protect client or source confidentiality.

© NUEXCO 1990

LOAN TRANSACTIONS[1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity (thousand pounds of U_3O_8 equivalent)	Approximate Price Range[2] as Percent of Current Loan Rate	Lender	Borrower	Remarks
4726	1990	301-600	98-102	Intermediary	R[3]	
4730	1990	301-600	98-102[4]	Intermediary	Utility	

CONVERSION SERVICES SPOT MARKET SALES[1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity (thousand pounds of U equivalent)	Approximate Price Range[2] as Percent of Current C.V.	Seller	Buyer	Remarks
4720	1990	101-300	98-102	Intermediary	Utility	
4728	1990	101-300	93-97	Intermediary	Utility	

ENRICHMENT SERVICES SECONDARY MARKET SALES[1]

NUEXCO Transaction Number	Delivery Period	Approximate Quantity[5] (thousand SWUs)	Approximate Price Range[2] as Percent of Current SWU Value[6]	Seller	Buyer	Remarks
4723	1991-93	101-300	R[3]	Producer	Utility	
4733	1990	50-100	98-102	Intermediary	Utility	
4735	1991	50-100	98-102	Intermediary	Utility	

[1] Transactions listed are not limited to those in which NUEXCO was involved, but also include others of which NUEXCO is aware. NUEXCO may delay reporting some transactions in order to protect proprietary information.
[2] The range reflects five percentage points (inclusive) per grouping, centered about the middle of the range.
[3] The notation **R** means that NUEXCO either does not know, or that NUEXCO has restricted that information to protect client or source confidentiality.
[4] This rate could be evaluated at less than 3.5 percent under certain circumstances.
[5] If tails assay is unknown or unspecified, NUEXCO's calculation of SWU quantity assumes 0.30 w/o tails assay.
[6] Prices are usually normalized to 0.30% tails assay. When prices and SWU values are expressed as discounts from a reference price (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage price range is based on the discounted prices, not on the reference price.

© NUEXCO 1990

NUEXCO

CURRENT MARKET DATA

URANIUM SUPPLY
(January 31, 1990)

NUEXCO Project Number	Delivery Period[1] (Thousand Pounds of U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale			
ACTIVE			
88-1096A*	965	—	1990, UF_6e
89-1001*	1,300	1,300 per year	1990-93, UF_6
89-1180	1,000	—	1990
89-1188	60	—	1990
89-1201*	2,000	2,000 per year	1990-93
89-1252	375	375 per year	1990-96
89-7000A	500	—	1990, UF_6
Total	**6,200**		
INACTIVE			
89-1029	1,200	300 per year	1990-98
89-1076	500	250 per year	1990 on
89-1128	1,130	—	1990, U_3O_8/UF_6
89-1156	200	—	1990
89-1173*	1,000	—	1990
89-1209	400	400 per year	1990-93
90-1000A*	655	—	1990, UF_6e
90-1003*	2,000	—	1990
87-1000	—	600 per year	1991-95
87-1123	—	1,000 per year	1990 on
88-1157	—	1,000 per year	1990 on, UF_6
Total	**7,085**		

* New or revised since last month.

[1] Measured from the date of this Report.
[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 87-1005, 87-1109, 89-1194.

© NUEXCO 1990

URANIUM DEMAND
(January 31, 1990)

NUEXCO Project Number	Delivery Period[1] (Thousand Pounds of U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase: ACTIVE			
89-1183	400	—	1990
89-1218	1,000	1,000 per year	1990-93
89-1229*	100	—	1990
90-1001	350	—	1990
90-1008*	132	—	1990
90-1009*	260	—	1990, UF_6
90-1015*	260	—	1990, UF_6
88-1227	—	1,600	1990-95, U_3O_8/UF_6
89-1090	—	150 per year	1991-96
89-1172	—	500 per year	1992 on
89-1176	—	600 per year	1991-96
89-1192	—	1,200	1992-97
89-1233	—	160	1991, UF_6
89-1236	—	250	1991-94, U_3O_8/UF_6
89-1242	—	75 per year	1992-94
89-1254	—	270 per year	1991-2000
89-1256	—	200 per year	1991-94
89-1260	—	250 per year	1992-94
90-1017*	—	500	1991
Total	2,502		
INACTIVE			
89-1067	**500**	**—**	**1990**
89-1163	**1,000**	**—**	**1990**
89-1175	**170**	**170 per year**	**1990-91**
Total	**1,670**		

* New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 89-1167, 89-1187, 89-1237, 89-1258.

© NUEXCO 1990

NUEXCO

CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(January 31, 1990)

NUEXCO Project Number	Delivery Period[1] (Thousand Pounds of U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
ACTIVE			
88-1182	4,000	—	U_3O_8/UF_6
89-1186	200	—	U_3O_8
89-1225	700	—	U_3O_8
89-1248	750	—	U_3O_8
90-1016*	1,000	—	U_3O_8
Total	**6,650**		

INACTIVE

None reported

Inquiries to Borrow:

No inquiries to borrow are reported

* New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 87-1167, 89-1077, 89-1196, 89-1206.

© NUEXCO 1990

CONVERSION SUPPLY AND DEMAND
(January 31, 1990)

NUEXCO Project Number	Delivery Period[1] (Thousand Pounds of U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale			
ACTIVE			
89-7000C	400	—	
89-7001A	440	—	
89-7002*	400	—	
Total	**1,240**		
INACTIVE			
None reported			
Inquiries to Purchase			
ACTIVE			
89-1245*	—	5,000	
Total			
INACTIVE			
None reported			

* New or revised since last month.
[1] Measured from the date of this Report.
Projects removed since last month: 89-1251.

© NUEXCO 1990

NUEXCO

CURRENT MARKET DATA

SWU SUPPLY AND DEMAND
(January 31, 1990)

NUEXCO Project Number	Delivery Period [1] (Thousand SWUs) Spot or Near-term [2]	Intermediate or Long-term	Remarks
Available for Sale			
ACTIVE			
88-1082*	100	—	1990
88-1096B*	140	—	1990, UF6e
89-7000B	300	—	1990
89-7001B	125	—	1990
Total	**665**		
INACTIVE			
88-1210*	200	200 per year	1990-93
90-1000B*	150	—	1990, UF6e
Total	**350**		
Inquiries to Purchase			
ACTIVE			
88-1236	250	—	1990-94
89-1243	150	—	1990
88-1061	—	500	1991-95
89-1262	—	120 per year	1996-99
Total	**400**		
INACTIVE			
89-1043	50	—	1990
89-1047	—	600	1991-95
Total	**50**		

* New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes SWU deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 87-1128, 88-1200, 89-1203.

© NUEXCO 1990

RECENT DEVELOPMENTS

NAMIBIA

Namibian Independence Date Set

On January 31, eleven days ahead of schedule, the Namibia's Constituent Assembly formally established March 21 as the date for Namibian Independence. The Assembly, elected less than three months ago, has also almost completed drafting the nation's first constitution. Only seventeen clauses remain to be written by March 21.

Touted as being one of the most liberal in Africa, the constitution would establish Namibia as a sovereign republic founded on the principles of democracy. It would abolish capital punishment, making Namibia the only African nation without the death sentence, and would include an enforceable bill of rights.

Despite fears that the South West Africa People's Organization (SWAPO), with a 57-percent majority in the Assembly, would strive to incorporate its own language in the constitution, very little controversy actually arose during the drafting. SWAPO made a number of concessions, however, such as allowing a political system of proportional representation, dropping preventive detention, and placing restrictions on certain powers of the Presidency. This latter issue was only recently resolved, as SWAPO's leader Sam Nujoma is almost certain to be named President.

South Africa is expected to approve the independence timetable, and US sanctions against imports of Namibian uranium should be lifted on March 21, by means of a Presidential Executive Order. ■

SWEDEN

Nuclear Phaseout Plans Under Review

As the onset of Sweden's planned nuclear energy phaseout approaches, Sweden is reassessing its energy policy. Faced with increasing demand for electricity, yet legislatively barred from adding generating capacity from fossil fuels or hydropower, the 1980 public decision to completely eliminate nuclear power by 2010 no longer appears feasible. In addition, the 1988 Parliamentary decision to shut down the first two of Sweden's 12 plants in 1995 is under scrutiny, and time to construct their replacement capacity extremely limited.

The issue has caused dissent within the ruling Social Democratic Party (SDP), and resulted in heavily publicized debates on energy policy in the fall of 1989. In October, the government established a committee (the "Group of Four") to reconcile the opposing views of the ruling Social Democratic Party and labor groups on a national energy policy. Appointed to the Group of Four were:

- Ingvar Carlsson, Prime Minister;
- Birgitta Dahl, Minister of Environment and Energy;
- Rune Molin, Vice Chairman of the Federation of Labor Unions;
- Stig Malm, Chairman of the Federation of Labor Unions.

On January 9, Prime Minister Carlsson announced a reorganization of the government, and transferred energy matters from the Ministry of Environment and Energy to the Ministry of Industry, headed by Rune Molin. Birgitta Dahl, formerly in charge of Environment and Energy, was charged with heading the new Ministry of Environment.

© NUEXCO 1990

NUEXCO

RECENT DEVELOPMENTS

Molin led the Social Democratic Party's anti-nuclear referendum in 1980, and although he continues to defend his earlier promise to phase out nuclear power, he no longer specifies when it will take place. Neither Molin nor Dahl will confirm the 1988 Parliamentary decision to begin the phaseout in 1996, and Molin has said that "nuclear power shall be phased out when possible considering employment and welfare."

The future of the SDP—more specifically its reelection in September 1991—hinges on developing a national energy policy acceptable to both the government and the labor unions. The SDP has very little time, since, in order to gain the support of most Party members, an energy policy must be agreed upon before the Congress of the SDP commences in September 1990. The Group of Four has said an agreement can be expected in April.

There are indications that the Group of Four may be considering not only whether the phaseout should begin in 1995, but whether it should occur at all. Following a meeting of leaders of Nordic Social Democratic Parties and labor unions, the Danish daily newspaper *Politiken* reported on January 19 that the closure of Barseback nuclear power plant was "hanging by a thread." Prime Minister Carlsson stated that each Parliament session was independent of earlier ones, and thus decisions made previously were not binding on successor Parliaments. He added that the Swedish government was under pressure to entirely abandon the phaseout, and that it was contemplating postponing the phaseout's commencement by three years.

According to a November 1989 public survey by SIFO, a well-known Swedish public polling institute, a majority of the public now opposes the government policy. Approximately 53 percent of the public support the use of nuclear power beyond 2010, while 25 percent believe nuclear power should not be phased out at all. In addition, the public has confidence in the safety of Swedish nuclear plants, and also believes in the safe disposal of nuclear waste.

A clarification of the party line should be forthcoming in 1990, and although it will probably include delaying the phaseout, it is unlikely to acknowledge yet that nuclear energy is an indispensable part of Sweden's energy mix. ■

© NUEXCO 1990

WASHINGTON FOCUS

Congress reconvened on January 23, but most of Washington's January news involves the Administration. DOE sent two letters to USEC customers, awarded a contract for the independent financial review of the enrichment program, and released a plan for demonstrating AVLIS by 1992. A General Accounting Office (GAO) report investigating the impact of imports of Soviet EUP into the US was made public. Both Congress and the administration are reportedly considering a full-scope US–Soviet Agreement for Nuclear Cooperation. Finally, published reports indicate Congress may consider ending the customs user fee which levies a charge of 0.17% on the value of all imported goods. The fee is felt to violate the General Agreement on Tariffs and Trade (GATT) and is not based on recovering actual Customs costs for processing a good. The fee brings the Treasury over $700 million per year, but the business community plans to lobby hard for its outright elimination or a change in authority to collect the fee based on actual costs.

Congressional Agenda

Looking ahead at the second session of the 101st Congress, budget hearings will take precedence over most other legislative business early in the year, but both the Senate and the House of Representatives have taken up Clean Air Act Amendments bills. In the air toxics section, which includes radionuclide emissions, the debate will center around dual regulation. The Sen. Alan K. Simpson (R-WY) amendment eliminates EPA authority under the Clean Air Act for NRC-regulated facilities. Sen. George J. Mitchell (D-ME), during the holiday recess, noted that this amendment would prevent states from passing and enforcing stricter radionuclide standards. (**Table 1** presents a summary of current and final radionuclide emission rules which has been corrected from the table printed on page 14 of last month's Report.) Other nuclear issues which will probably receive Congressional attention

Table 1
SUMMARY OF CURRENT AND FINAL RULES
(Corrected from last month)

Source Category	Number of Facilities	Current Rules	New Rules
DOE facilities	45	25 mrem/yr	10 mrem/yr EDE [1]
NRC licensees	6,000	25 mrem/yr	10 mrem/yr EDE [1]
Nuclear reactors and support facilities	135	25 mrem/yr	10 mrem/yr EDE [1]
Underground uranium mines	15	Bulkheads	10 mrem/yr EDE [1]
Uranium tailings (disposal)	46	20 pCi/m^2-s radon	20 pCi/m^2-s radon
Uranium tailings (operations)	4	Close within 6 years and apply new technology	20 pCi/m^2-s radon Close unlined piles
Uranium tailings (new construction)	0	Phased/continuous disposal	Phased/continuous disposal
DOE radon sources	5	No rule	20 pCi/m^2-s
Phosphogypsum stacks	40	No rule	20 pCi/m^2-s
Elemental phosphorus plants	5	21 Ci/yr Po-210	2 Ci/yr Po-210
High-level nuclear waste facilities	0	No rule	No rule
Coal-fired boilers	1,500	No rule	No rule
Surface uranium mines	2	No rule	No rule

Source: *ANS Nuclear News*, December 1989
[1]Effective dose equivalent

© NUEXCO 1990

NUEXCO

this year are: resolving the high-level waste repository siting impasse, promoting advanced reactor technologies and standardization, restructuring the uranium enrichment program, and reorganizing the NRC.

DOE Activities:

USEC

In an attempt to respond to its customers' desire for flexibility, DOE sent out two letters this month to USEC holders. On January 11 DOE mailed utilities a supplemental agreement to their US contracts which allows the customer an additional 30 days to confirm the specific assay if the product is below 4.5% or until day 120 if the order specifies a standard assay (2.0, 2.8, 3.4, 4.0 and 4.45 w/o U^{235}). On January 22, DOE announced it would waive for one year the April 1, 1990 notice for FY 2000 deliveries required under the US contract.

Enrichment Restructuring

DOE also announced the awarding of a $2.5-million contract to Smith Barney for an independent financial review of the Department's uranium enrichment business. This contract will have three subcontractors—Coopers & Lybrand, Skadden, Arps, Slate, Meagher & Flom, and Nuclear Assurance Corporation. Smith Barney must submit its final report by mid-May. DOE hopes the report will generate enough interest in Congress, particularly in the House of Representatives, so that hearings to consider restructuring the enterprise will proceed.

AVLIS

On January 19, DOE released its plan for the "Demonstration, Transition and Deployment of AVLIS." The plan develops an industrial access program for the technology in 1990, which will be followed by the selection of a commercial deployment contractor in 1991. It also describes the milestones necessary to demonstrate AVLIS technology at plant scale by September 1992. DOE projects costs of $550 million to demonstrate the technology by November 1992 when a deployment decision will be made. Predeployment activities (none of which have been initiated yet) include site selection, engineering design efforts, the National Environmental Protection Act (NEPA) documentation, and Nuclear Regulatory Commission (NRC) licensing. The plan, which is based on eventual construction of a nine-million SWU capacity plant, is said to show a return on investment of between 9 and 20 percent if DOE or a government corporation deploys the plant, or 17-24 percent if a private company deploys it. No justification for these numbers, however, was released with the report.

FY 1991 Budget

President Bush submitted his budget to Congress on January 29th. In a press briefing the same day DOE's Assistant Secretary for Nuclear Energy William Young presented an overview of the department's nuclear budget. The budget request for uranium enrichment increased from $1.412 billion in FY 90 to $1.480 billion for FY 91. Young indicated that the environmentally-related accounts of the enrichment budget request are 50-percent higher than last year. AVLIS receives an increase from $132 million to $154.5 million. It is clear that the government's decision not to proceed with the Special Isotopic Separation program (SIS), which last year DOE admitted was financially linked to AVLIS, will affect the schedule and funding for AVLIS this year. As partial payment of the $364 million debt, $29 million is requested, and a Decontamination and Decommissioning (D&D) fund is established with $50 million.

© NUEXCO 1990

The total nuclear energy budget request increased from $2.417 billion to $2.539 billion. The nuclear energy R&D budget increased from $341.8 million to $357.8 million, but advanced reactor R&D actually decreases from $58.7 million to $47 million. Young hopes the design certification program will result in one large (1,200-MWe) ALWR design certification by 1991. Congressional hearings on DOE's budget will begin in late February and continue through March. It is likely DOE's budget allocations will change before Congress gives its final approval.

Soviet Enrichment Imports

Rep. Marilyn Lloyd (D-TN) released a GAO study concerning utilities' use of Soviet enrichment and its impact on the US market. The GAO concluded that no Soviet uranium, and a relatively small amount of enriched uranium, was imported directly into the USA. However, it found that Soviet SWU coming into the European market had lowered prices and stimulated US purchases of other enrichment services. GAO could not find any evidence that utilities were "flag swapping" to conceal purchases of Soviet enrichment. The report notes that the Soviet Union is increasing its efforts to sell SWU to Western customers to earn the foreign exchange required for continued development.

US-Soviet Nuclear Cooperation

Both the administration and Congress may consider broadening the scope of US–Soviet relations on nuclear activities this year. A Congressional Research Service report published December 13, 1989 discusses the merits of a full-scope US–USSR Agreement for Nuclear Cooperation. The report noted that the first nuclear agreement which allowed some scientific and technical cooperation on the peaceful uses of nuclear power was signed in 1973. The original 1973 agreement covered cooperation in three areas: controlled thermonuclear fusion; fast breeder reactors; and research on basic theoretical physics. Cooperation increased substantially after the Chernobyl accident in 1986. Although the current agreement expired December 20, 1989, renegotiations are underway and there is some talk of expanding the scope of the agreement.

The report notes the Soviet Union collaborated with the USA on the Non-Proliferation Treaty, and also allows the IAEA to inspect some of its civilian facilities. The Soviet Union also permits IAEA safeguards to be applied to nuclear materials and equipment for export. Even during times of strained bilateral relations the report notes "The Soviet Union continued periodic non-proliferation meetings with the USA."

There is a continuing debate within the government about whether technology transfer to the Soviet Union benefits or harms US national security. Whether Congress or the administration will actually pursue this idea remains to be seen. ■

© NUEXCO 1990

NUEXCO

RECENT DEVELOPMENTS

Nuclear Fuel Industry Developments

December	
22	Citing non-compliance with current safety regulations, the **North Rhine-Westphalia** State government regulators **shut down** the **Würgassen** BWR. Preussenelektra AG (Preag), the plant's owner, retaliated by filing suit against the State for ordering the closure. The matter is not expected to be resolved for some time, and the plant, the only remaining nuclear power plant in North Rhine-Westphalia, will remain closed.
27	**Poland** placed a one-year hold on further construction of its **Zarnowiec** nuclear station due to economic uncertainties. The country plans to revise its energy policy in the interim, and is under pressure to hold a public referendum on nuclear energy's future role in Poland.
January	
4	**Rio Algom, Ltd.** announced the **shutdown** of its **Quirke** and **Panel** mines at Elliot Lake in early 1991 due to depressed uranium prices and low-grade ores. Together, Quirke and Panel accounted for about 75 percent of Rio Algom's 1988 production of six million pounds U_3O_8.
8	Eight months ahead of schedule, Philadelphia Electric Company's **Limerick 2** entered **commercial operation**.
9	As part of the reorganization of the **Swedish Government,** Rune Molin was appointed Minister of Industry and charged with energy matters. Although committed to the eventual **nuclear phaseout**, Molin concedes that 1995 is too early for the phaseout to commence. (See article on page 13).
10	**Argentina's Atucha 1** reentered service after being down nearly a year and a half for repairs. The 335-MWe PHWR will be limited to 50 percent of capacity for the next few months.
12	**Chevron Resources** ceased mining and production at its **Mt. Taylor** mine in New Mexico, noting that uranium would have to be selling for around $20 per pound for the mine to remain open. Mt. Taylor was New Mexico's last active uranium mine; twelve years ago New Mexico had 55. **Kennecott Corp.** signed a **letter of intent** with **Crested Corp.** and its parent company **US Energy**, to jointly explore, develop, and produce uranium in Wyoming. RTZ Corp. owns 100% of Kennecott, which it acquired in 1989. The 50-million pound Jackpot deposit is included in the venture. **Denison Mines Ltd.** has sued **Rio Algom Ltd.** for $35 million in damages, claiming it has lost the ability to mine "significant" ore reserves in its Elliot Lake properties due to inadequate pillar support in Rio Algom's adjacent mine. Denison says it was forced to close its adjacent shafts for safety reasons.
13	The **Canadian government** announced it was establishing a **license fee schedule** for nuclear power plants in order to make the Atomic Energy Control Board (AECB) self-supporting. The utility owners of the country's 18 nuclear plants will provide about one-half of the expected C$28 million in annual license fees.

© NUEXCO 1990

Nuclear Fuel Industry Developments
(continued)

January	
15	**Nuclear power,** at US$0.062 (9 yen) per KwH, was **Japan's cheapest source of electricity** in 1989, according to the Ministry of International Trade & Industry.
15	**Czechoslovakia's Energy Minister** announced **suspension of construction** on **two nuclear units** at Temelin, largely due to pressure from neighboring Austria. Construction will continue on the first two Temelin units, which are expected to be completed in 1992 and 1994.
19	**Rheinisch-Westfälische Elektrizitätswerke AG (RWE)** announced its **reorganization** and new name of RWE AG. RWE AG will act as a holding company for nearly 150 companies arranged under five major subsidiaries: RWE Energie AG (electricity), Rheinbraun AG (mining), RWE-DEA AG (chemical and oil), RWE Entsorgung AG (non-nuclear waste disposal), and Lahmeyer AG (electrical equipment). Nuclear power will fall under RWE Energie, and Rheinbraun AG will control Rheinbraun Australia Pty. Ltd. (a shareholder in the Ranger project) and Uranerz Exploration and Mining, Ltd. Uranit, the German shareholder in Urenco, and Nukem have not yet been assigned to any of the five subsidiaries; neither company is a wholly-owned subsidiary of RWE.
19	**France's Commissariat à l'Enérgie Atomique (CEA)** proposed the **reorganization** of its operations, eliminating several management positions and replacing the semi-autonomous Institutes with seven divisions reporting directly to the CEA Administrator. The proposed plan is designed to provide the CEA with more flexibility to respond to future opportunities.
22	**DOE waived** for one year the **April 1990 notice requirement** for FY 2000 deliveries, in an apparent acknowledgement that its customers prefer shorter term contracts in order to maintain their flexibility.
25	**DOE** filed suit against the State of **Nevada** for preventing further site characterization of the final nuclear waste repository.
	Pakistan's Atomic Energy Commission has **abandoned** the country's only **uranium mine** after two employees were killed in local fighting.

© NUEXCO 1990

NUEXCO

SOVIET URANIUM SUPPLY CAPABILITY

Introduction

Soviet exploration for uranium began in 1946. Before that time only one USSR uranium deposit was known—"the Taboshary"—near Tashkent in the Republic of Uzbekistan. It was explored in 1936 and was the base for an experimental radium plant. Since 1946, a large number of exploration programs have been carried out, resulting in the discovery of numerous uranium deposits, both in the Asian and European parts of the USSR. Current Soviet production planning calls for comprehensive extraction of all valuable minerals from any deposit being exploited, since this offers economic and environmental advantages over selective extraction of only the most valuable components.

Until recently, the Soviet uranium mining industry concentrated on satisfying domestic requirements for nuclear energy and defense programs. International marketing activity was largely limited to the export of enrichment services under long-term contracts to West European countries. However, for the same reasons as the rest of the world, the Soviet Union added nuclear fuel cycle production capacity in anticipation of demand increases that have not taken place. Thus, the USSR has substantial excess capacity available for the production of nuclear fuel materials for export.

The USSR is undertaking a vigorous effort to expand its nuclear fuel trade with countries in Western Europe, North America, and the Far East for the 1990s. Techsnabexport (TSE) handles the marketing and export sales for Soviet

Figure 1. The MeLovoe lignite mine on the shore of the Caspian Sea. Note the very high stripping ratio and the

© NUEXCO 1990

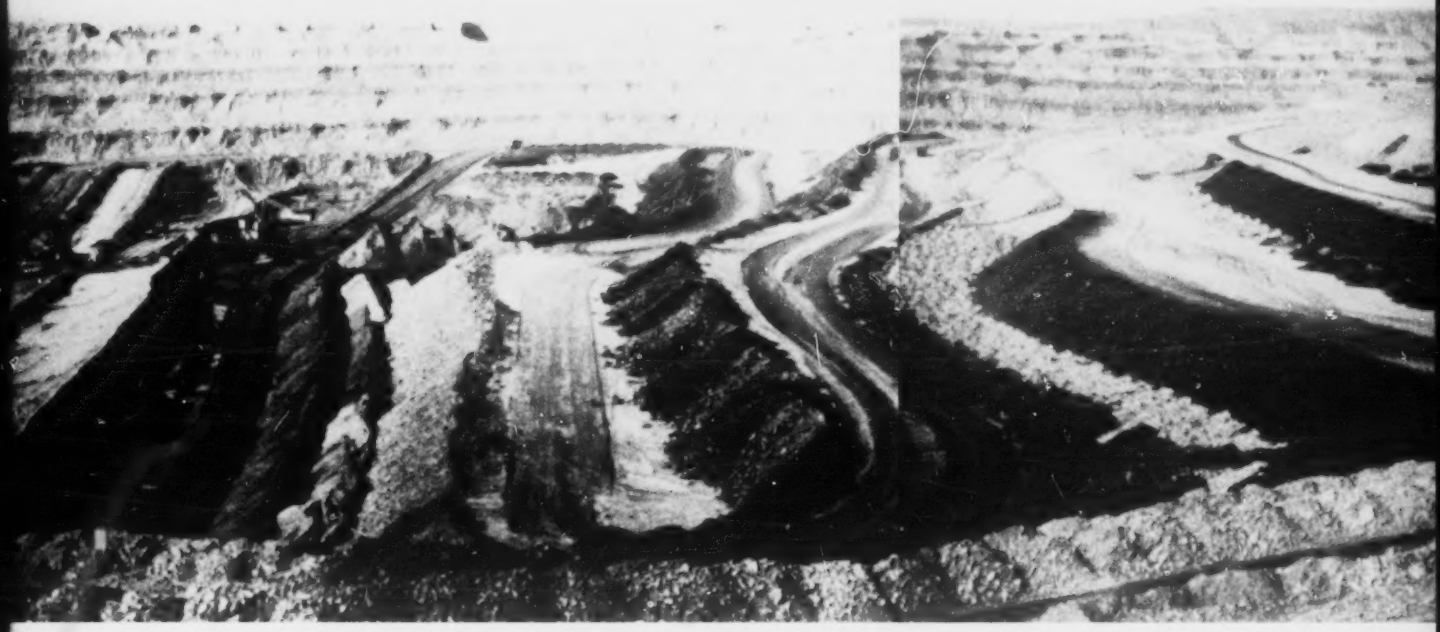
nuclear fuel. TSE is the commercial arm of the USSR Ministry of Atomic Energy and Industry (MAEI) which oversees the Soviet Union's nuclear fuel production industry.

This article describes some of the many active uranium production centers in the Soviet Union. A more comprehensive listing of uranium deposits and processing centers is shown in **Table 1**. Eight processing plants are noted in this article as receiving ore from specific mines or groups of mines; there are at least ten plants in the USSR, including two chemical and metallurgical plants, that produce uranium concentrate. The concentrate is shipped from the milling facilities to any of three conversion plants. The original is at Zholtye Vody in the Ukraine, the second is at Chkalovsk in the southern Ferghana district, and the third is at Kara Belta in northern Kirgiziya. Uranium hexafluoride is transported from the conversion plants to one of two enrichment plants. The main plant is at Zholtye Vody, and another is located at Chkalovsk.

Reserves

Commercially viable uranium deposits (reserves) in the Soviet Union are characterized by great diversity in distribution and type. A number of them have no parallel in other countries. Large deposits have been related to submarine-delta and marine formations, such as the Mangyshlak peninsula (near the city of Shevchenko). Alluvial deposits of ancient riverbeds have been found to contain formations with relatively small uranium reserves.

The most important reserves are found in sandstone (such as the Uchkuduk deposit in Central Asia). Approximately 60 percent of reserves in the Soviet Union are found in sandstone-type deposits and 40 percent are found in vein-type deposits. Identified reserves of uranium are ample for Soviet nuclear energy requirements for more than 100 years (at average rates of development of nuclear energy and if reprocessing is continued).



bucketwheel excavator. This lignite is burned in a nearby power station and the ash is leached to recover uranium.

© NUEXCO 1990

Table 1
Soviet Uranium Deposits and Processing Centers

Deposit	Description
European USSR	
1. **Sillimae**	• Uranium-phosphate rare earth association in clays with detrital fishbones. Uranium mining and milling operations.
2. **Zholtye Vody-Terny**	• Precambrian uranium-iron ore formation. Irregular stratiform albitized uranium bodies. Uranium in association with conglomerates. Uranium minerals include uraninite, pitchblende, and nenadkevite. Uranium mining and milling.
3. **Lermontov**	• Uranium-molybdenum associated with volcanic rocks. Mining and milling operations.
4. **Chupa District**	• Uraniferous pematites in Precambrian gneisses. Uranium mineralization in paleovolcanic and intrusive rocks of Baltic shields.
5. **Lake Onega**	• Uranium and vanadium mineral in association with black graphitic marine shales, peat, and asphaltite.
Urals	
6. **Vishnevogorsk**	• Uranium mineralization in nepheline syenite intrusions.
7. **Novogornyy**	• Uranium mineralization in nepheline syenite.
Kazakhstan and Central Asia	
8. **Aksuyek-Kiyakhty**	• Uranium mining.
9. **Koktas**	• Uranium associated with copper mining.
10. **Stepnogorsk**	• Possible in-situ leaching of deep-seated uranium deposit. Uranium extraction as part of the "Tselinnyy Mining Complex."
11. **Ak-Tyuz-Bordunskiy**	• Uranium and rare earths associated with lead mining.
12. **Chigirik**	• Uranium milling and processing facilities.
13. **Granitogorsk**	• Uranium possibly associated with lead mining, milling, and concentration center.
14. **Min-Kush**	• Uranium mining and milling operations associated with lignite.
15. **Tyuya-Muyan**	• Uranium-vanadium association in metamorphic limestone interlayered with volcanic tuffs and breccia. Tyuyamuyunite, a uranium-vanadium mineral species that was named after this locality.
16. **Kyzyl-Dzhar**	• Uranium mining associated with gold production.
17. **Kadzhi-Say**	• Uranium associated with lignite mining.
18. **Taboshar**	• Uranium vanadium mining. U_3O_8 extraction plant.
19. **Chkalovsk**	•Uranium extraction and hexafluoride conversion site for Taboshar mine ore.
20. **Sumsar**	• Possible uranium mining.
21. **Uchkuduk**	• Uranium associated with gold mining at Kokpatas gold mine. Possible uranium extraction at Navoi Mining and Metallurgical Complex. Ore genetically similar to South African deposits.
22. **Naugarzan**	• Uranium-fluorite mining. Ore milling at Chigirik.
23. **Charkesar**	• Site of former uranium mining.
24. **Chavlisay-Krasnogorskiy Yangiabad**	• Site of uranium mining operation.
25. **Kara-Balta**	• Uranium processing center.
Siberia	
26. **Vikhorevka**	• Possible uranium mining of vein-type deposits in ultrametamorphic Archean rocks.
27. **Krasnokamensk**	• Uranium-fluorspar association in Mesozoic volcanic basins.
28. **Slyudyanka**	• Pegmatites-uranium and rare earths. Mining reported in 1958 from Precambrian crystalline limestone.
29. **Aldan**	• Uranium and rare earths associated with gold mining.

© NUEXCO 1990

Production Methods

Uranium in the Soviet Union is largely recovered through by-product or co-product mining operations, or by in-situ leaching (ISL). For example, **Figure 1** shows a lignite mine at the MeLovoe deposit on the Mangyshlak Peninsula, Kazakhstan.

At present, ISL accounts for 20 percent of uranium concentrate production, but is expected to account for up to 45 percent in coming years due to cost effectiveness and technological improvements. In the USSR, the low overhead and economies of scale resulting from large, efficient mining operations operated by one company tend to keep production costs low, relative to other countries. The recovery of a number of by-products enhances the value extracted from many deposits.

Uranium ores are processed at MAEI's large hydrometallurgical plants. These plants yield a variety of high purity uranium oxides and many useful by-products associated with uranium (molybdenum, rhenium, scandium, vanadium, gold, copper, rare earth elements, and phosphate, mixed and nitrate fertilizers).

Ion-exchange technology forms the basis of commercial methods of extracting uranium and various associated elements from ores, concentrates, and natural and mine waters, and of obtaining high-purity compounds of these elements. The development of durable and efficient ion exchange resins has been a notable achievement of the Soviet mining industry, and their use offers significant cost advantages.

Because of the great diversity of ores processed and the presence of different associated elements, the order of technological processes differs for different plants. Ore preparation methods also differ, different methods are used for dissolution, and the final stages for obtaining the associated elements differ. All the Soviet technologies, however, involve non-filtration adsorption-extraction, which ensures their technological and economic efficiency.

Mines and Mining Districts

Four mining districts have been the major source of the Soviet Union's domestic uranium production. An additional four or five production centers have been less prolific, but their combined output has made important contributions to total uranium supply. **Figure 2** shows some of the reported uranium mining centers in the western and central parts of the Soviet Union.

The first sustained uranium recovery operation began in 1908 at the **Tyuya-Muyun** mine located in the northern Alai Mountains of the Uzbekistan district near the border of China and Afghanistan. Originally, uranium was removed from the mineral concentrates because of the need to purify the other products. More than 900 metric tons of uranium concentrates were recovered as a by-product of copper and vanadium mining during the next seven years. Uranium was recovered almost continuously until the late 1950s. The deposit's average ore grade is about 1.5 percent U_3O_8.

In the early years of mine life, the relatively high-grade ore averaged almost four percent copper, 2.5 percent vanadium, and approximately one percent uranium. The average grade of mined uranium over the years is not known, but a large ore reserve remains, having an average uranium content of 1.5 percent U_3O_8, with high-grade zones exceeding four percent. The main uranium mineral is tyuyamunite, a calcium and uranium vanadate, named for the mine site of Tyuya-Muyun hill.

Adjacent mines and others in the northern sector of the **Chatkal/Ferghana region** are currently producing by-product uranium, primarily from fluorspar ores and lignite. A rich mineral trend extends northward from the Tyuya-Muyun mine area to the Ferghana region, continuing northward into the province of **Kazakhstan**, where copper has been mined for many years. Uranium mineralization occurring in association with the copper ore has been recovered as a co-product since the late 1950s. The mineralized complex contains large tonnages of highly disseminated copper and uranium ore, indicating that the mine is likely to be a long-term supplier of uranium.

© NUEXCO 1990

Uranium Production Centers:

1. Sillimae
2. Zholtye Vody
3. Lermontov
4. MeLovoe
5. Central Ural Mountains
6. Uchkuduck
7. Chatkal/Ferghana Region
8. Vikhorevka
9. Lake Baykal
10. Krasnokamensk

Figure 2. Location map of uranium production centers in western and central USSR. Each location represents one or more production centers.

© NUEXCO 1990

One of the most important production centers lies in the northern sector of the Krivoi Rog iron district in the Dnepropetrovsk Province of the west-central Ukraine. Uranium mining began in the mid-1940s at the **Terny** and **Zholtye Vody** mines, two of the country's first production centers. Uranium originally was the primary product at both mines, but later became a co-product of iron production. Although the Terny mine was closed in 1969, the Zholtye Vody mine continues to produce. (This district is described in Report 194, page 21.)

Molybdenum and uranium are co-produced at mines in several districts, primarily in the western and central parts of the Soviet Union. Uranium from this source is important to the total supply program because of the wide distribution of occurrences and the strategic importance of domestic molybdenum production.

Chatkal/Ferghana District

Most mining in this district has used underground methods. Mines have been developed at strategic locations on the different vein structures. The deepest mines exceed 500 meters in depth, and in some cases are connected by lateral workings. The mined ores are shipped to Chkalovsk via the Great Ferghana Canal for processing. Uranium concentrate is recovered from the ores and is further processed at a nearby conversion plant.

The Chatkal/Ferghana district has 25 to 30 other active mines in which uranium is either the primary mineral recovered or a by-product. The district is the largest source of uranium in the USSR. The mines at **Taboshar** and **Maylisay** produce uranium disseminated in a sandstone formation. Each mine has its own processing plant. The uranium content varies from about 0.10 percent to 0.20 percent U_3O_8. In the nearby Kara-Tau mountains, uranium is associated with copper and vanadium at the **Bela Sauskandyk** mine. Pitchblende is the dominant uranium mineral present; secondary uranium minerals often are associated with zones of intense hydrothermal alteration.

On the northern flanks of the Kurama mountains are a number of mines from which uranium is recovered as a by-product of fluorspar, copper, and lignite. The **Naugarzan** mine is the largest fluorspar and uranium mine in the district. Mining began in 1964. The mined ores are shipped directly to a fluorspar mill located at Toytepa; a rough uranium concentrate is separated from the fluorspar and shipped directly to the uranium mill at **Chkalovsk**.

Uranium is recovered as a by-product from lignite burning in at least three different locations. The **Min-Kush** and the **Tsentralnaya** mines are located in the southern portion of the district, the **Almalyk** mine is located about 20 kilometers north of Osh. The latter is the largest mine. It began open-pit production in 1962 and has maintained an annual production level of just over 180,000 metric tons of lignite. The Min-Kush mine is also an open pit, producing about 120,000 metric tons of lignite annually. Initial annual production at the Tsentralnaya mine was about 90,000 metric tons of lignite using underground mining methods. Open-pit mining of the deposit began about 1970, and the annual capacity is well over 100,000 metric tons. The lignite is burned to produce power and the ash from each project is leached at a nearby plant to recover the uranium. The concentrate subsequently is transported to the conversion plant located at Kara-Belta, which has been the main conversion facility for the southern district since the early 1950s.

In the central part of the district, uranium is recovered as a by-product from lead ore mined at the **Bordunskiy, Ak-Tyuz**, and **Orlovka** mines. The uranium is recovered at the Kirgiziya metallurgical complex located near Orlovka, probably using flotation techniques. Finally, uranium is recovered as a co-product from gold ores produced at several mines situated in the **Kyzyl Dzhar** mining district. It is likely that the gold ores are processed at the Kirgiziya complex, and the uranium is separated from the ore by flotation. Also, the uranium concentrate is probably leached and precipitated as ammonium diuranate (ADU).

The northern sector of the Chatkal/Ferghana district has only recently developed into an important uranium-producing area. In the southern Kazakhstan republic, an extensive mineralized trend has been discovered to contain a variety of minerals. Most important are the vast reserves

© NUEXCO 1990

of prophyry-type copper mineralization disseminated throughout metamorphic and igneous rock hosts, much of which is known to contain significant quantities of uranium. Open-pit and underground primary copper mines have been developed along the trend. Uranium is a co-product in at least five of the mines. The largest uranium production center may be the Stepnogorsk underground mine located northeast of Tselinograd. Uranium and copper occur in a vein system containing considerably higher grade than the disseminated ores.

Other uranium mines include the **Koktas, Kiyakhty, Aksuyek**, and **Akbabay** mines located to the south near Lake Balkash. Each is an open-pit mine where low-grade uranium is mined as a co-product of copper. The rough uranium concentrate from those mines is collected for shipment to the Tseliny Mining and Chemical Complex near Stepnogorsk. Uranium concentrate is shipped elsewhere for further processing.

Other Uranium Districts

Molybdenum-uranium deposits are found in a variety of geologic settings. Most occur in association with hydrothermal mineralization related to sedimentary deposition in close proximity to volcanic and intrusive rocks of Paleozoic age. Primary mineralization is disseminated in the volcanics and intrusives. Diorite dikes and volcanic pipes and plugs are frequently mineralized. The mineral suite may contain uranium and sulfide minerals such as molybdenite, galena, and pyrite. Higher-grade ores often are found near intrusive contact zones and in sediments. Zone of contact metamorphism, especially in sediments (sandstones and conglomerates) are highly favorable for ore accumulation.

Pitchblende is the main uranium mineral present, forming low-grade ore where disseminated, and often increasing in percentage at the contact zone and within the sediments. The most important deposits are situated where rock structure has been influenced by hydrothermal activity adjacent to fault and fracture zones. The mineralization is confined to vein systems, veinlets, and in stockworks where intense alteration has taken place.

Low-grade molybdenum-uranium occurrences have been discovered in Proterozoic rocks of the Siberian and Aldan shield regions. The mineral accumulation probably is the result of precipitation from hydrothermal solutions invading intensely fractured rock. Titanium and iron are common mineral constituents in the more complex occurrences.

Uranium is recovered as a by-product of phosphoric acid production at **Sillimae** near the Baltic Sea coast in Estonia. It is the largest phosphate-uranium operation in the USSR. Uranium is contained primarily in fish bone detritus common to the phosphate deposit. The uranium values are low, in a range of approximately 40 to 90 parts per million in the phosphate-bearing rock. However, the demonstrated association between uranium and the detritus material suggests that higher uranium values are likely to occur where the detritus has accumulated as a result of depositional changes.

The recovery of uranium from the phosphate begins with the acidulation of the phosphate rock. In this wet process, the phosphate is completely digested by sulfuric acid. Under ideal conditions, approximately 90 percent of the contained uranium is stripped from the acid stream through the application of basic solvent extraction technology. Large quantities of phosphatic fertilizer and uranium are manufactured annually and vast ore reserves assure the project's longevity.

Uranium also is recovered from the waste water generated during the refining process of petroleum products from the Ukhta oilfields located in the Pechora Basin, in the northern part of Western USSR. Uranium and radium metals contained in the oil are taken into solution and remain there through the final stage of refinery use. The metals are recovered by precipitation from the process water. Oil production amounts to millions of barrels annually, suggesting that uranium recovery from this project is high.

© NUEXCO 1990

Conclusion

For many years, only limited information concerning uranium deposits in the USSR has been available from Soviet sources. The Soviet Union has, however, cooperated in some past efforts to promote interaction with the international scientific community. For example, in 1984 the Soviet Union hosted the 27th International Geological Congress (IGC). The uranium portion included 50 papers, primarily on uranium deposits in sandstone and metamorphic rocks, presented to about 300 members.

The IGC sponsored almost 400 geology field trips, the most noteworthy of which was a five-day trip to the Krivoi Rog iron and uranium district in the south-central Ukraine, including visits to two open-pit iron mines and the underground Novaya uranium mine in Zholtye Vody. That conference was reported in detail in the October 1984 NUEXCO Monthly Report (No. 194, pp. 21-24). Some other information that has been made available over the years is contained in the April 1985 Report (No. 200, pp. 21-25) discussion of uranium deposit classifications.

Advanced processing technology, low-cost labor, by-product and co-product recovery, and the large existing production capacity enable MAEI to produce nuclear fuel at low cost. The Soviet Union's reserve base, technological development, and production experience make it one of the world's leading producers of nuclear fuel. As additional information is made available for publication, NUEXCO will present updated reports on the nuclear fuel cycle facilities in the Soviet Union. ■

© NUEXCO 1990

REPUBLIC OF SOUTH AFRICA
Fourth Quarter 1989 Production

South Africa's uranium producers continue to be plagued by increased costs and falling uranium prices, in addition to markets diminished as a result of political pressures. Working cost increases came from the doubling of gold production costs in the last five years, due to lower gold ore grades and greater working depths. These increased costs have further hampered South Africa uranium producers' ability to compete in the current uranium market. After a modest loss of 2.4 percent in production volume in 1988, 1989 production tumbled an additional 23.5 percent, from 9.7 million pounds U_3O_8 in 1988, down to 7.4 million pounds in 1989.

Only one mine—Western Areas—managed to increase uranium output between 1988 and 1989. Production decreases for the other five members of the Chamber of Mines ranged from three percent to ten percent. Vaal Reefs, the largest South African uranium producer, showed a 5.4 percent decline from the previous year, but still produced more than half of South Africa's total uranium output in 1989.

These difficult economic conditions have reduced the number of operating mines to seven (including Palabora), where twelve were operating just three years ago. ■

Table 1
REPUBLIC OF SOUTH AFRICA
RECENT URANIUM PRODUCTION[1]
(Thousands of Pounds U_3O_8)

Operation	First Quarter 1989	Second Quarter 1989	Third Quarter 1989	Fourth Quarter 1989	TOTAL 1989	Percent Change[2]
Buffelsfontein	231	216	221	187	855	-15.4
ERGO[3]	109	105	80	87	382	+8.8
Freegold[4]	256	224	262	236	978	-9.9
Hartebeestfontein	199	182	183	195	759	+6.6
Vaal Reefs	962	941	1,011	1,021	3,935	+1.0
Western Areas	117	112	131	136	496	+3.8
TOTAL[5]	**1,874**	**1,780**	**1,888**	**1,863**	**7,404**	**-1.3**

[1] Excludes Palabora Mining Company, which is not a member of the Chamber of Mines.
[2] Change in percent from the third quarter of 1989.
[3] ERGO = East Rand Gold and Uranium Company Ltd.
[4] Formerly Free State Joint Metallurgical Scheme.
[5] Columns may not add up due to rounding.

© NUEXCO 1990

PROJECTED URANIUM REQUIREMENTS OF DEVELOPING COUNTRIES

The following is an edited version of the paper presented by Treva E. King of NUEXCO Information Services before the Uranium Institute's Supply/Demand Committee in London, England, on January 19, 1990.

Introduction

The objective of this paper is to examine the uranium requirements of developing countries both in aggregate and individually. Although the cumulative uranium requirements of these countries are expected to account for less than eight percent of total requirements, the fact that many of these countries are expressing renewed interest in nuclear is, in itself, encouraging. The countries analyzed in this paper are Argentina, Brazil, Egypt, India, Israel, Mexico, Pakistan, South Africa, South Korea and Taiwan.

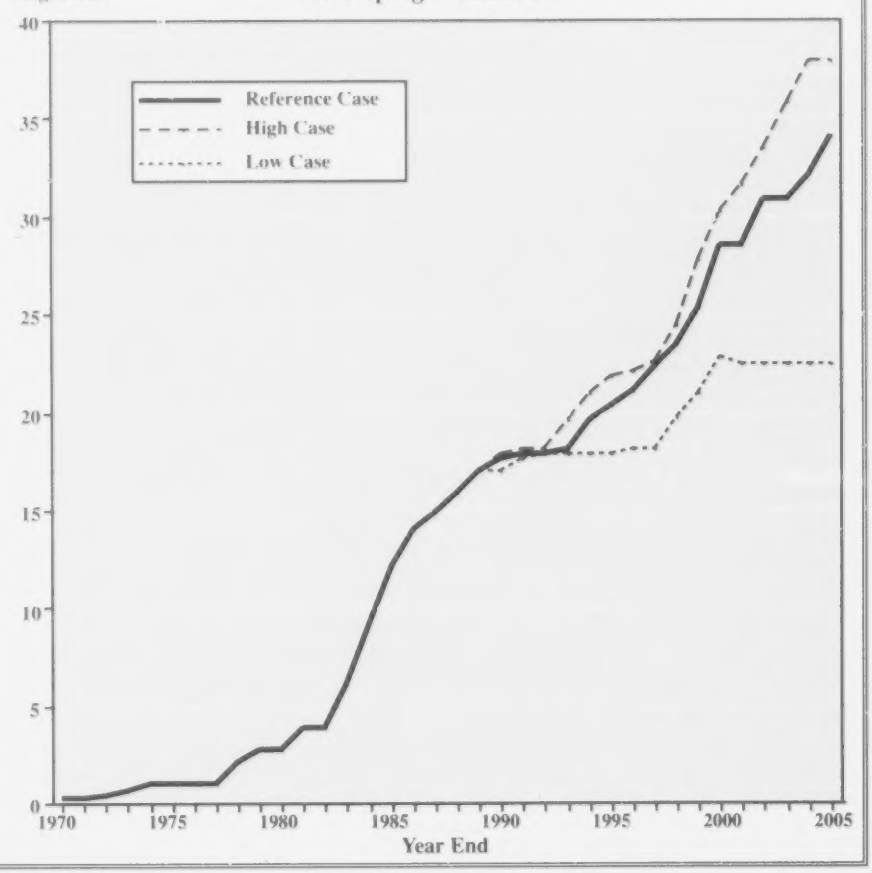
For each country, the existing and planned nuclear capacity levels have been identified and capacity factors have been projected. For countries with no previous nuclear power, the world weighted average capacity factor for the specific reactor type is utilized. Other factors influencing nuclear power demand and operations of these developing countries will be discussed, and finally, uranium requirements based on a calculated optimal tails assay of .30 will be provided.

Nuclear Electric Capacity

Three projection cases for installed nuclear electric capacity are developed incorporating varying degrees of optimism/pessimism regarding completion dates of reactors under construction, cancellation of partially constructed reactors, and the construction start and completion dates of planned and unplanned future reactors.

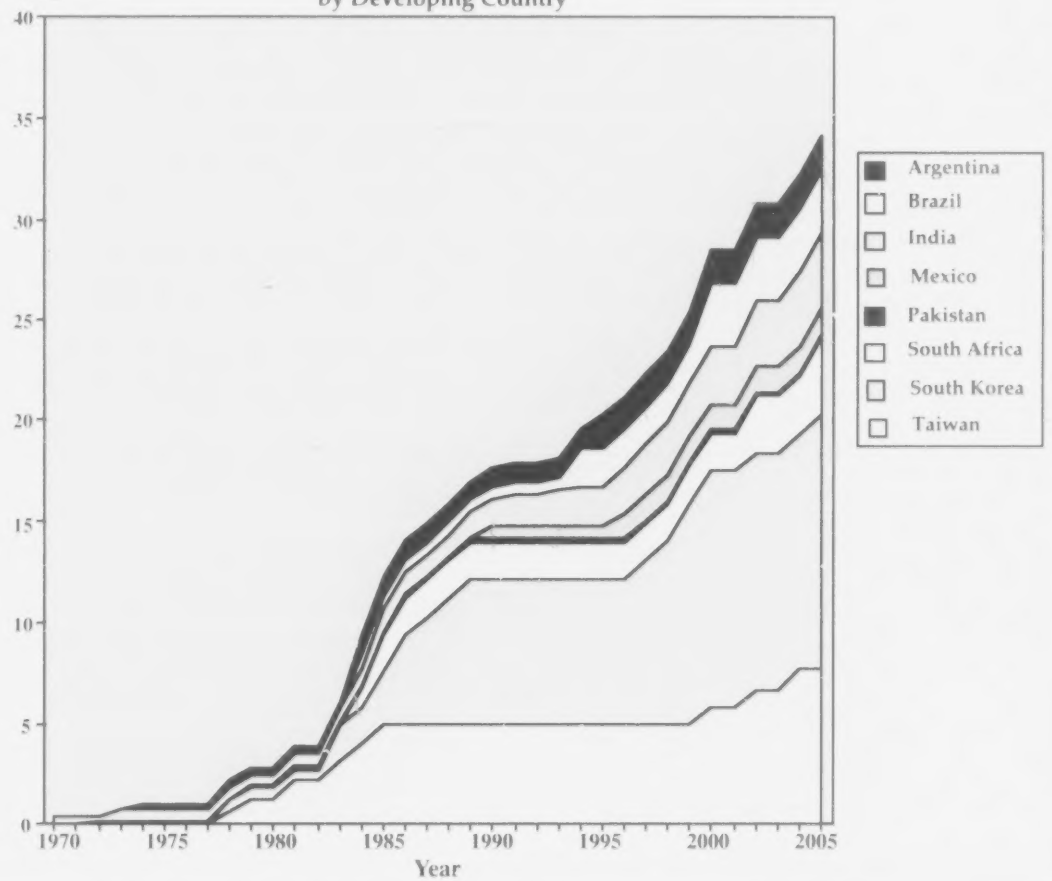
The reference growth case assumes some slippage from announced schedules of reactors under construction and

Figure 1
Historical and Projected
Installed Nuclear Electric Capacity
– Developing Countries –



© NUEXCO 1990

Figure 2
Historical and Projected
Installed Nuclear Electric Capacity
by Developing Country



most reactors whose construction is presently halted are assumed to be cancelled. The low growth case assumes more slippage and that all reactors with halted construction programs are cancelled. The high growth case assumes reactors under construction will be completed as scheduled and that most halted reactors will eventually be completed.

Figure 1 shows the three projection cases of historical and projected installed nuclear capacity for the developing countries. Nuclear growth is expected to proceed rapidly in the developing countries, increasing 65 percent from 1989 to 2000 in the reference case.

Figure 2 shows the installed nuclear electric capacity by country in the form of a stacked area chart. As of 1989, South Korea and Taiwan represent about 70 percent of the total capacity, however, their share declines to just over 57 percent by 2000, as Argentina, Brazil, India and Mexico shares increase.

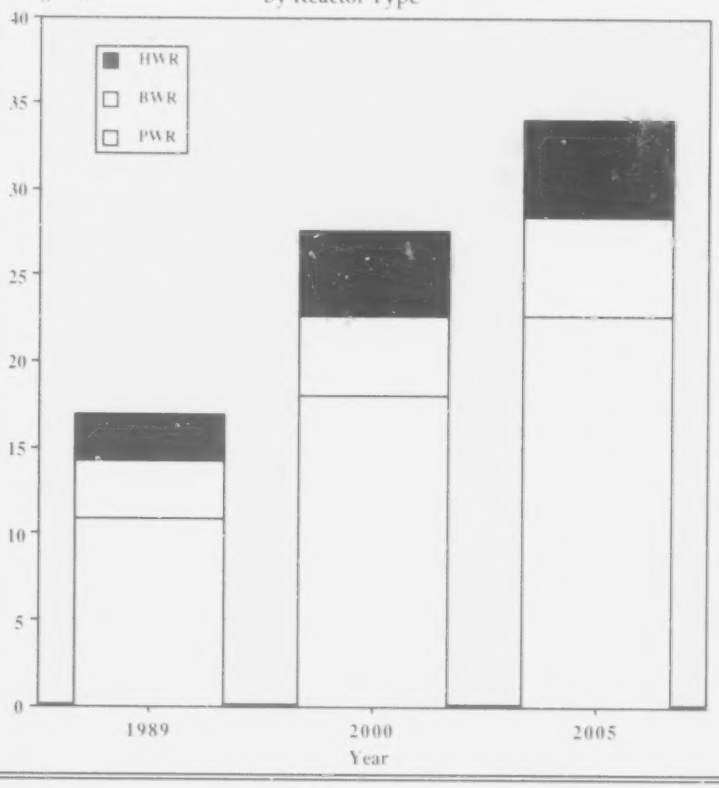
Information on projected electric capacity by reactor type for the key years of 1989, 2000, and 2005, is shown in **Figure 3**. Although the PWR predominates, the heavy water reactor is favored by several developing countries because it does not require enriched uranium, which can be difficult for a developing country to obtain due to safeguards considerations.

© NUEXCO 1990

Table 1
Historical Plant Capacity Factors
–Developing Countries–

Year	Capacity Factor
1979	58.3
1980	64.1
1981	65.3
1982	53.6
1983	61.1
1984	67.5
1985	63.5
1986	58.1
1987	66.1
1988	65.2

Figure 3
Historical and Projected
Installed Nuclear Electric Capacity
by Reactor Type



Capacity Factors

Historical plant capacity factors for the developing countries are shown in **Table 1**. They ranged from a low of 53.6 percent to a high of 67.5 percent in 1984. The mean was 62.3 percent for the period shown. To determine future capacity factors, individual reactor data was processed to yield a capacity-weighted average capacity factor for each reactor type in each country for three years (1986, 1987, 1988). These averaged values were used as the capacity factors in 1989 for that reactor type in that country.

In order to allow for reasonable future improvements in plant operating reliability, it is assumed that an increase of 25 percent of the difference between an assumed theoretically "perfect" capacity factor and the 1989 capacity factor will be achieved. This methodology yields small additional capacity factor improvement for countries/reactor types presently experiencing high capacity factor values and a larger improvement for those currently experiencing low capacity factors. No further improvement is assumed after 2000. For countries with no previous nuclear power, the world weighted average capacity factor for that reactor type is utilized.

Country Summaries

The countries analyzed in this paper are now discussed individually. **Table 2** provides a list of reactors, both operating and under construction, for each country.

Argentina

Two nuclear power plants are in commercial operation. Atucha 1, a 335-MWe HWR supplied by KWU was down for repairs for 17 months until January 1990. Embalse, a 600-MWe CANDU HWR is currently in operation, however, it has recently suffered operational problems. During the past three years, these reactors have operated at an average capacity factor of 66

© NUEXCO 1990

Table 2

Reactors Operating and Under Construction in Developing Countries

Country	Reactor	Type	MWe Net	Percent Complete [1]	Commercial Operation Date
Argentina	Atucha 1	HWR	335	100	1974
	Atucha 2	HWR	692	64	1995
	Embalse	HWR	600	100	1984
Brazil	Angra 1	PWR	626	100	1984
	Angra 2	PWR	1245	69	1994
	Angra 3	PWR	1245	28	2000
Egypt	El Dabaa 1	PWR	900	0	1999
	El Dabaa 2	PWR	900	0	2003
India	Kaiga 1	HWR	220	18	1996
	Kaiga 2	HWR	220	18	1997
	Kakrapar 1	HWR	220	57	1993
	Kakrapar 2	HWR	220	44	1994
	Kalpakkam 1	HWR	215	100	1984
	Kalpakkam 2	HWR	215	100	1985
	Narora 1	HWR	220	100	1989
	Narora 2	HWR	220	85	1991
	Rajasthan 1	HWR	204	100	1973
	Rajasthan 2	HWR	184	100	1981
	Rajasthan 3	HWR	220	10	1998
	Rajasthan 4	HWR	220	10	2000
	Tarapur 1	BWR	160	100	1969
	Tarapur 2	BWR	160	100	1969
Israel	Shivta 1	PWR	900	0	2002
Mexico	Laguna Verde 1	BWR	654	100	1989
	Laguna Verde 2	BWR	654	53	1996
Pakistan	Kanupp	HWR	137	100	1972
South Africa	Koeberg 1	PWR	920	100	1984
	Koeberg 2	PWR	920	100	1985
South Korea	Kori 1	PWR	556	100	1978
	Kori 2	PWR	605	100	1983
	Kori 3	PWR	895	100	1985
	Kori 4	PWR	895	100	1986
	Uljin 1	PWR	943	100	1988
	Uljin 2	PWR	943	100	1989
	Wolsung	HWR	629	100	1983
	Yongkwang 1	PWR	900	100	1986
	Yongkwang 2	PWR	900	100	1987
Taiwan	Chinshan 1	BWR	604	100	1978
	Chinshan 2	BWR	604	100	1979
	Kuosheng 1	BWR	948	100	1981
	Kuosheng 2	BWR	948	100	1983
	Maanshan 1	PWR	890	100	1984
	Maanshan 2	PWR	890	100	1985

[1] Data on units under construction as of June 30, 1989. *Source: Nuclear News*

© NUEXCO 1990

percent, and provided 7.8 percent of Argentina's electric generating capacity in 1988. Atucha 2 is under construction, about 64 percent complete, and is projected for operation in 1995.

Argentina continues to pursue nuclear power, with the avid support of its recently elected President, Carlos Menem. Additional nuclear capacity would help reduce the severe electricity shortages the country has been experiencing. However, several issues must be addressed before Argentina can actively participate in nuclear energy. The country must sign the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) or another safeguards agreement, and it needs to resolve continuing national debt repayment problems, which are major obstacles to the financing of new reactors. This last problem can be partially offset by Argentina's continued active involvement in the export of research reactors.

Brazil

Angra 1, a 626-MWe PWR, is Brazil's only operating nuclear plant. It resumed operation in October 1988, following a 16-month outage for repairs and modifications, and entered its second refueling outage October 1, 1989. A municipal court order obtained by members of Brazil's Green Party had prevented the reactor from restarting, but an appeal, based upon a favorable review from a recent IAEA Operational Safety Review Team, was successful, and Angra 1 was restarted in January 1990.

Angra 2 and 3, both 1245-MWe PWRs, are under construction and scheduled for completion in the 1990s. There is some doubt as to whether construction will continue on the Angra 3 unit. Progress of nuclear power in the country has diminished due to slow growth in electricity demand, hyperinflation, and excessive foreign debt. Nuclear power made up only 0.3 percent of Brazil's 1988 electric generating capacity.

Brazil has also reorganized its nuclear industry by transferring responsibility for construction and engineering of nuclear power plants to the utilities. The government's role will be restricted to dealing with policy and regulatory issues.

Egypt

Two 900-MWe PWR reactors are expected to begin commercial operation in 1999 and 2003 at El Dabaa. However, negotiations have stalled on the proposed El Dabaa projects. Although bids were solicited for supply of the reactors, a supplier has not been selected. Egypt is reportedly considering a long-term energy strategy in which nuclear power plays a major role.

India

India has an aggressive nuclear power program in progress. Seven nuclear units are in operation and another seven are under construction. All of these are HWRs and are not dependent on enriched uranium. India completed negotiations with the USSR for the construction and financing by the USSR of two large PWR units, to be located in Kudankulam in Tamil Nadu state. Plans are also underway to construct two HWR units at Tarapur, and possibly four more HWR units at Rawatbhata in Rajasthan state.

Narora 1 achieved criticality in March 1989 and was operating commercially by the end of 1989. India's nuclear generating capacity is projected to grow rapidly in the next decade, despite the fact India has still not signed the NPT. India's reactors averaged a 48-percent capacity factor over the past three years, and made up three percent of India's 1988 electric generating capacity.

Israel

Shivta 1, a 900-MWe PWR is currently scheduled to begin commercial operation in 2002. Israel has expressed interest to several suppliers (AECL and Framatome) for the supply of the nuclear reactor. Their success may be limited unless they agree to sign the NPT.

Mexico

Mexico's first nuclear plant, Laguna Verde 1, a 654-MWe BWR, achieved first criticality near the end of 1988 and began commercial operation in 1989. Laguna Verde 2 is expected to begin operation in 1996.

Pakistan

Pakistan's Kanupp reactor, a 137-MWe HWR, has experienced a substantial decline in its capacity factor over the past few years. The plant was closed for several months due to a leak of heavy water in April 1989. The three-year average of 27.9 percent is expected to gradually increase to about 43 percent by 2000.

South Africa

The two-unit Koeberg PWR built by Framatome, supplied 7.3 percent of South Africa's electric generating capacity

© NUEXCO 1990

and reached a capacity factor of 65 percent in 1988. The station capacity factor during the last three years averaged 53 percent. Construction of additional nuclear generating capacity is currently being considered.

South Korea

Currently South Korea has eight PWRs and one HWR in operation totalling over 7,000 megawatts. The Uljin 1 unit, a 943-MWe PWR operating since 1988, was brought down for planned maintenance in October 1989. Uljin 2 began commercial generation September 30, 1989, but was taken off-line in November after experiencing operational problems. The Korean PWR's averaged a 75-percent capacity factor over the past three years, and the HWR averaged 84 percent. Nuclear power contributed 46.9 percent of South Korea's electric generating capacity in 1988. However, it will be the late 1990's before any additional units enter service.

Taiwan

Taiwan's last nuclear unit entered service in 1985. Six units are presently in operation, with an installed nuclear capacity of 4,900 MWe. These units constitute about 30 percent of Taiwan's electric generating capacity, but generate about 50 percent of the total electricity production due to their base load operation. Taiwan's reactors averaged a 68-percent capacity factor over the past three years.

Taiwan's nuclear program has been beset with uncertainty and indecision since 1985 when the Ministry of Economic Affairs suspended plans for a seventh and eighth reactor. In the meantime, coal fueled units are under construction. The government and Taipower are attempting to restore public confidence in and to promote public understanding of nuclear power through extensive public relations. In 1988, the Atomic Energy Council of Taiwan invited an international panel of nuclear safety experts to review nuclear safety practices at Taipower plants. The panel praised Taiwan's nuclear program as well as Taipower's safety record, but indicated that in some respects the performance could be improved.

Uranium Requirements

Based on the reference growth case for nuclear capacity, the aggregate uranium requirements for developing countries show substantial growth in the late 1990s and early 2000. **Figure 4** indicates an increase of over 100 percent from 1990 to 2005, which represents approximately a seven-percent average annual growth rate.

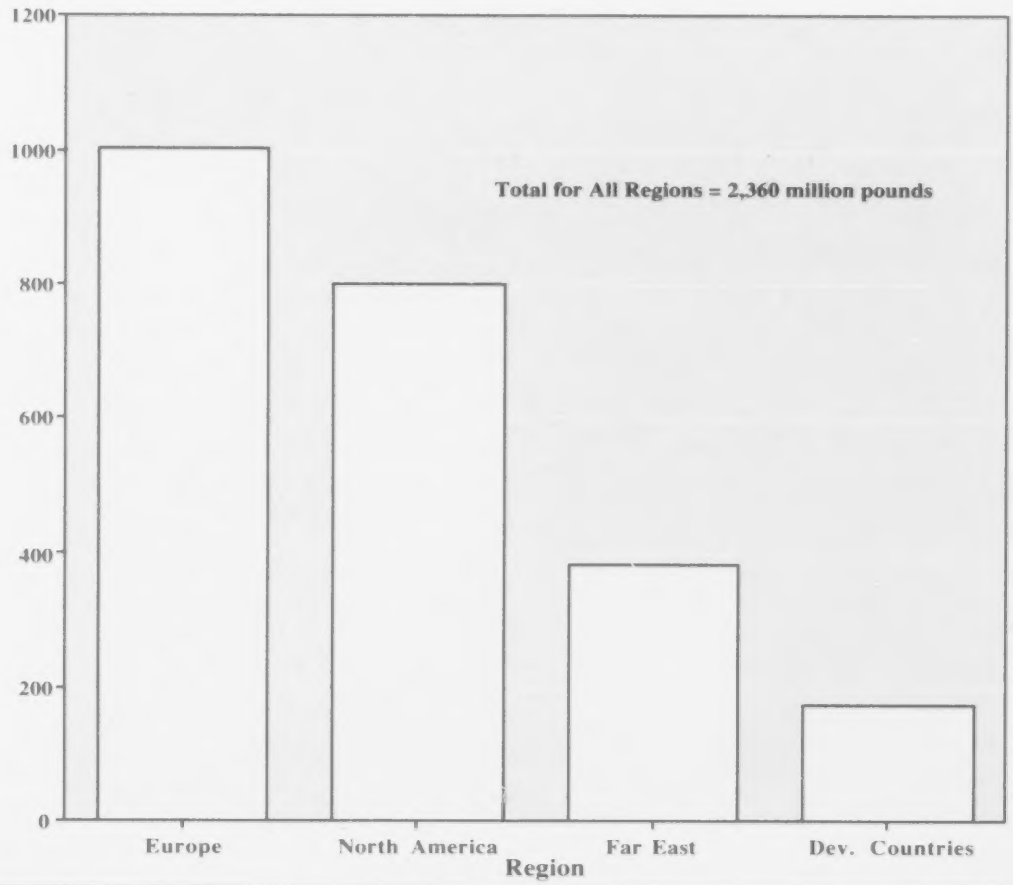
© NUEXCO 1990

Cumulative uranium requirements by country for 1990 through 2005 are shown in **Table 3**. South Korea and Taiwan are expected to have the most significant uranium requirements, averaging about 7.5 million pounds annually. It should be noted that the cumulative requirements include needs for operating reactors and reactors under construction, as well as any known planned and future reactors. Although these developing counties are planning substantial additions of nuclear power, resulting in increased uranium requirements, their effect on world uranium requirements is minimal. **Figure 5** provides a look at the cumulative uranium requirements by region. ■

Table 3
Cumulative Uranium Requirements by Country 1990 – 2005

Country	Thousand lbs U_3O_8
Argentina	8,235
Brazil	7,739
India	13,107
Mexico	7,005
Pakistan	425
South Africa	14,988
South Korea	73,271
Taiwan	42,877

Figure 5
Cumulative Uranium Requirements by Region
- Reference Case - 1990 - 2005



© NUEXCO 1990

NUEXCO

CALENDAR

Nuclear Industry Calendar

1990	
Feb. 25 - Mar 1	***Waste Management '90*** (Tucson, Arizona), sponsored by the University of Arizona, Department of Nuclear Energy Engineering and Mines, Tucson, AZ 85721.
Mar. 4-8	***7th Pacific Basin Conference*** (Sheraton Harbor Island Hotel, San Diego, California), sponsored by the ANS. Contact the ANS Meeetings Department at 1-312-352-6611.
Mar. 12-15	***Radioactive Material Transportation Basic Workshop*** (Oak Ridge, Tennessee). Contact Teresa Yearwood at 1-615-482-9031.
Mar. 25-28	***Fuel Cycle '90 Conference*** (Opryland Hotel, Nashville, Tennessee), sponsored by the US Council for Energy Awareness. Contact the USCEA Conference Office at 1-202-293-0770.
Apr. 8–12	***First Annual International High-Level Radioactive Waste Management Conference*** (Caesar's Palace Hotel, Las Vegas, Nevada), sponsored by the American Nuclear Society and American Society of Civil Engineers. Contact the ANS at Meeetings Department at 1-312-352-6611.
Apr. 9-11	***23rd JAIF Annual Conference*** (Kyoto, Japan). Contact Ms. Sachie Sugoh, Dept. of Planning and International Affairs, JAIF, at 03-508-9056.
Apr. 22-25	***INFO '90*** (Westin Hotel, Dallas, Texas), sponsored by the USCEA. Contact the USCEA Conference Office at 1-202-293-0770.
Apr. 23-27	***1st Regional Seminar for the Middle East and Europe on Management of Quality for Nuclear Power Projects*** (Prague, Czechoslovakia). Contact Conference Service Section, IAEA, P.O. Box 100, A-1400, Vienna, Austria.
May 15-17	***Annual Meeting on Nuclear Technology 90*** (Nuremburg, FR Germany). Contact Deutsches Atomforum e.V., Conference Office JK 90 at 0228 507223.
June 3-7	***30th Annual Conference of the Canadian Nuclear Association and 11th Annual Conference of the Candian Nuclear Society*** (Toronto, Canada). Contact Canadian Nuclear Association, 111 Elizabeth Street, Toronto, Ontario, Canada M5G 1P7.
June 4-8	***International Symposium on Nuclear Techniques in Exploration and Exploitation of Energy and Mineral Resources*** (Moscow, USSR). Contact Conference Service Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.
Sept. 4-7	***International Seminar on the Costs and Financing of Nuclear Power in Developing Countries*** (Jakarta, Indonesia). Contact Conference Service Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.

© NUEXCO 1990

Nuclear Industry Calendar (continued)

1990

Sept. 5-7	***Uranium Institute 15th Annual Symposium*** (London, United Kingdom). Contact the UI at 44-1-225-0308.
Sept. 16-19	***Uranium Seminar '90*** (Hyatt Regency, San Antonio, Texas), sponsored by the USCEA. Contact the USCEA Conference Office at 1-202-293-0770.
Nov. 11-14	***Nuclear Energy Forum*** (Washington Hilton, Washington, D.C.), sponsored by the USCEA and ANS. Contact the USCEA Conference Office at 1-202-293-0770, or the ANS Meetings Department at 1-312-352-6611.

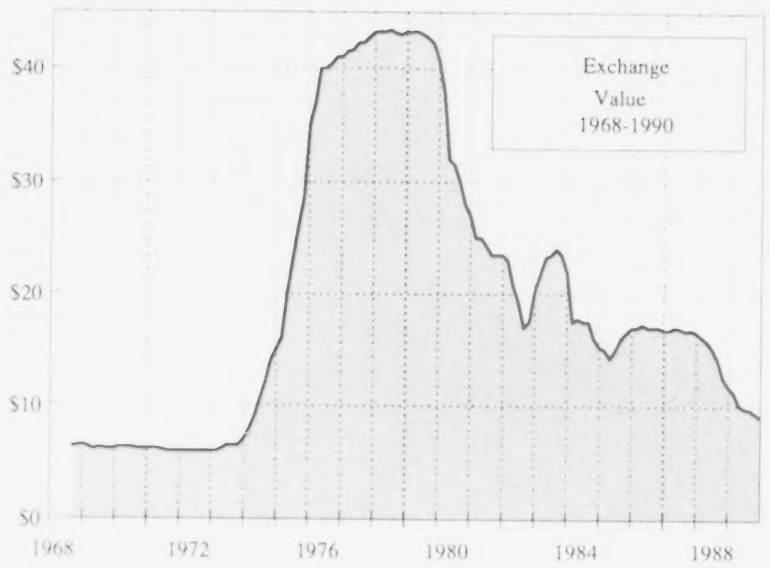
© NUEXCO 1990

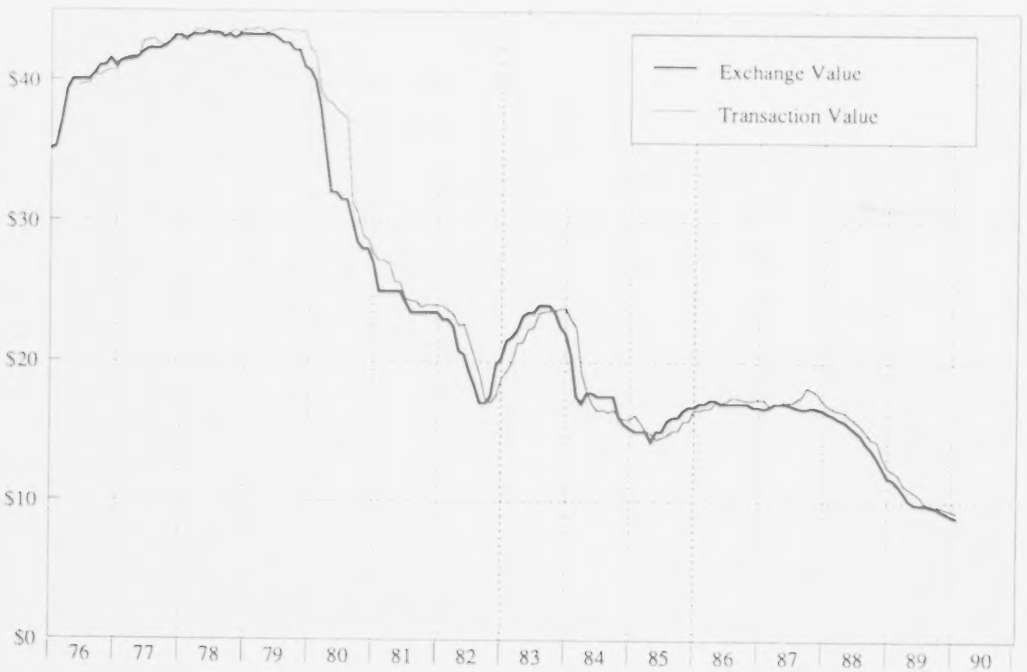
NUEXCO

HISTORICAL MARKET DATA

NUEXCO Historical Exchange and Transaction Values

(In US Dollars/Pound U_3O_8)





© NUEXCO 1990

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated ($US/lb U_3O_8)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	16.00	16.00	16.50	16.75	17.00
1986	17.00	17.00	17.25	17.25	17.00	17.00	17.00	17.00	17.00	17.00	16.75	16.75
1987	16.65	16.75	17.00	17.00	17.00	16.90	16.75	16.65	16.65	16.75	16.65	16.55
1988	16.30	16.15	15.90	15.75	15.40	15.10	14.75	14.15	13.75	13.15	12.50	11.75
1989	11.60	11.20	10.70	10.10	9.85	9.80	9.80	9.70	9.60	9.40	9.20	9.00
1990	**8.85**											

HISTORICAL US PREMIUM (Relative to the Exchange Value)

Determined as of the last day of the month indicated ($US/lb U_3O_8)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	—	—	—	—	—	—	—	—	—	—	0.65	0.75
1987	0.85	1.00	1.50	1.50	0.90	0.60	2.50	2.35	2.10	1.65	0.85	0.65
1988	0.70	0.50	0.15	0.25	0.60	0.00	0.00	0.00	0.00	0.00	**None**	

© NUEXCO 1990

NUEXCO

HISTORICAL MARKET DATA

HISTORICAL UF_6 VALUES

Determined as of the last day of the month indicated ($US/kg U as UF_6)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	—	—	—	40.50	42.50	42.50	44.00	44.50	44.50	46.00	46.00	47.00
1986	47.00	48.00	48.00	48.50	48.25	48.25	48.25	48.00	48.00	48.00	48.00	47.75
1987	47.75	48.00	48.00	48.00	47.75	47.75	47.50	47.00	46.75	47.00	47.00	47.00
1988	46.50	46.00	45.50	45.25	44.75	44.00	42.75	41.00	40.75	39.00	37.50	35.50
1989	34.75	34.00	33.00	30.50	30.25	30.25	30.00	29.75	29.75	28.25	27.75	26.50
1990	**25.90**											

HISTORICAL US UF_6 PREMIUM (Relative to the UF_6 Value)

Determined as of the last day of the month indicated ($US/kg U as UF_6)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	—	—	—	—	—	—	—	—	—	—	2.50	2.50
1987	2.50	2.50	3.50	3.00	2.25	1.75	6.50	6.00	4.25	3.10	2.25	2.00
1988	1.25	1.25	0.50	0.50	1.00	0.00	0.00	0.00	0.00	0.00	**None**	

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated ($US/lb U_3O_8)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	15.10	15.10	15.75	15.80	16.55
1986	16.55	16.70	16.70	17.10	17.15	17.20	17.50	17.45	17.35	17.25	17.30	17.35
1987	17.35	16.90	16.95	17.00	17.20	17.10	17.30	17.55	18.20	18.05	17.80	17.20
1988	16.85	16.65	16.55	16.45	16.10	15.80	15.45	15.00	14.50	14.40	13.30	12.50
1989	12.25	12.00	11.25	11.00	10.75	10.45	9.95	9.80	9.80	9.65	9.55	9.40
1990	**9.25**											

© NUEXCO 1990

HISTORICAL LOAN RATES

Determined as of the last day of the month indicated (Percent/Annum)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	4.00	4.00	4.00	4.00	4.00
1969	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	6.00	6.00	6.00	6.00
1970	6.00	6.20	6.40	6.50	6.50	6.50	6.50	5.00	6.50	6.00	5.50	5.50
1971	5.00	4.75	4.75	4.75	5.00	5.25	5.25	5.25	5.25	5.25	4.50	4.50
1972	4.00	4.00	4.00	4.50	4.50	4.50	5.00	5.00	5.00	5.00	5.00	5.00
1973	5.50	5.50	5.75	5.75	6.00	6.25	7.00	7.00	7.00	7.00	7.50	8.00
1974	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
1975	8.00	7.00	7.00	7.00	7.00	6.50	6.50	6.50	6.50	6.50	6.50	6.50
1976	6.50	6.50	6.50	6.50	*	*	*	*	*	*	*	*
1977	*	*	*	*	6.50	6.50	6.50	6.75	7.25	7.25	7.25	7.25
1978	7.25	7.00	7.00	7.00	7.00	7.50	7.75	7.75	7.75	7.00	7.00	7.00
1979	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
1980	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
1981	7.00	7.00	7.00	7.00	7.00	5.50	5.50	5.50	5.50	6.00	6.00	6.00
1982	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1983	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1984	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1985	6.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1986	5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
1987	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	3.50	3.50
1988	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
1989	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
1990	**3.50**											

* Float with Prime Rate

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated ($US/lb U as UF6)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	1.60	1.60	1.60	1.60	1.60
1986	1.60	1.80	1.90	1.80	1.80	1.80	1.80	1.90	1.90	1.90	1.80	1.80
1987	1.80	1.80	1.80	1.80	1.80	1.80	1.90	1.90	1.90	1.90	1.90	1.90
1988	1.90	1.80	1.80	1.80	1.80	1.80	1.85	1.95	1.95	1.95	1.95	1.95
1989	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.90	1.90	1.80	1.75	1.65
1990	**1.65**											

HISTORICAL SWU VALUES

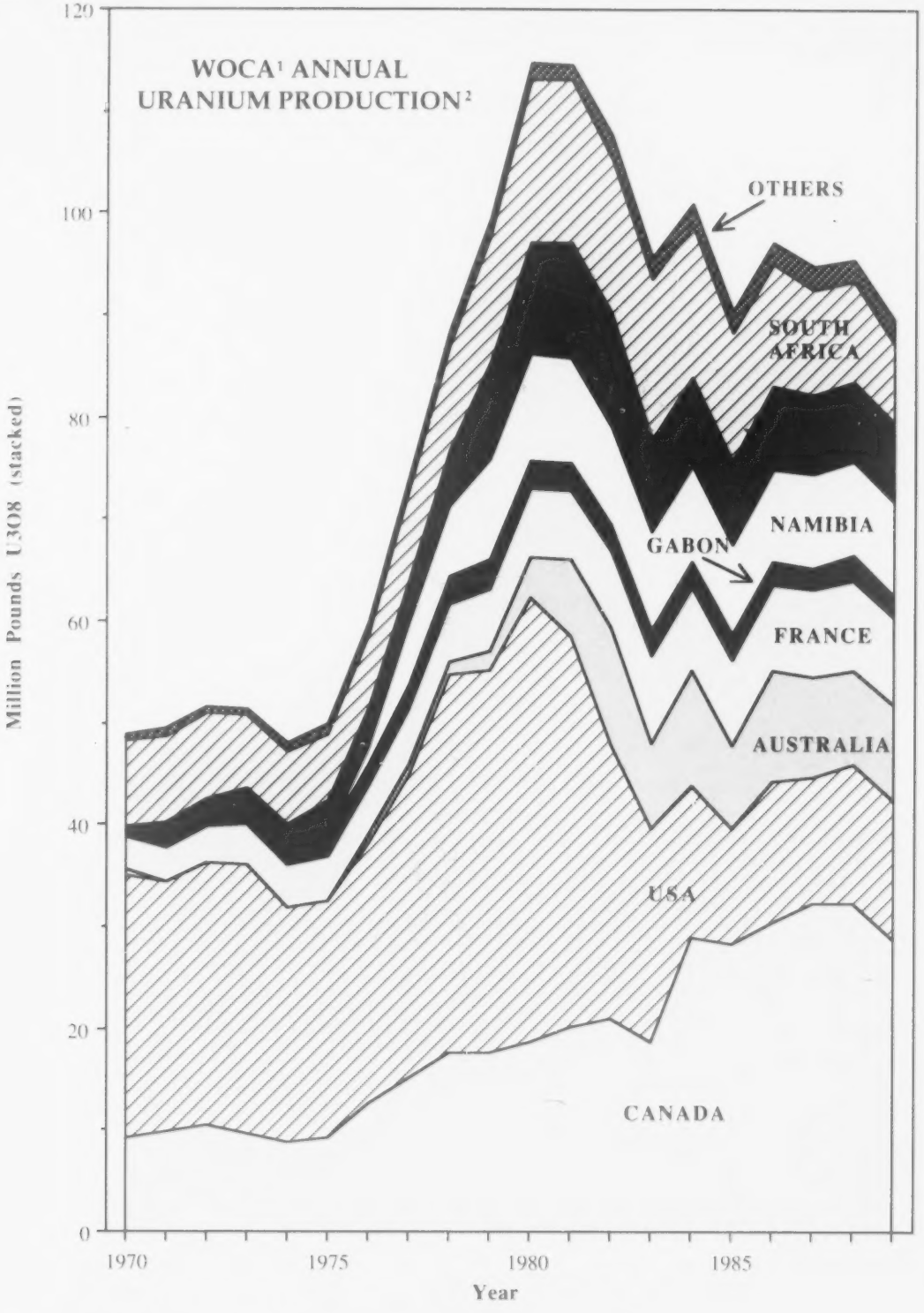
Determined as of the last day of the month indicated ($US/SWU)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	80	80	80	80	75	78	78	78	78	78	80	80
1987	80	80	77	77	75	73	75	75	73	69	73	73
1988	73	73	70	68	68	68	68	65	65	65	65	65
1989	65	67	67	67	66	66	66	65	63	59	57	54
1990	**54**											

© NUEXCO 1990

NUEXCO

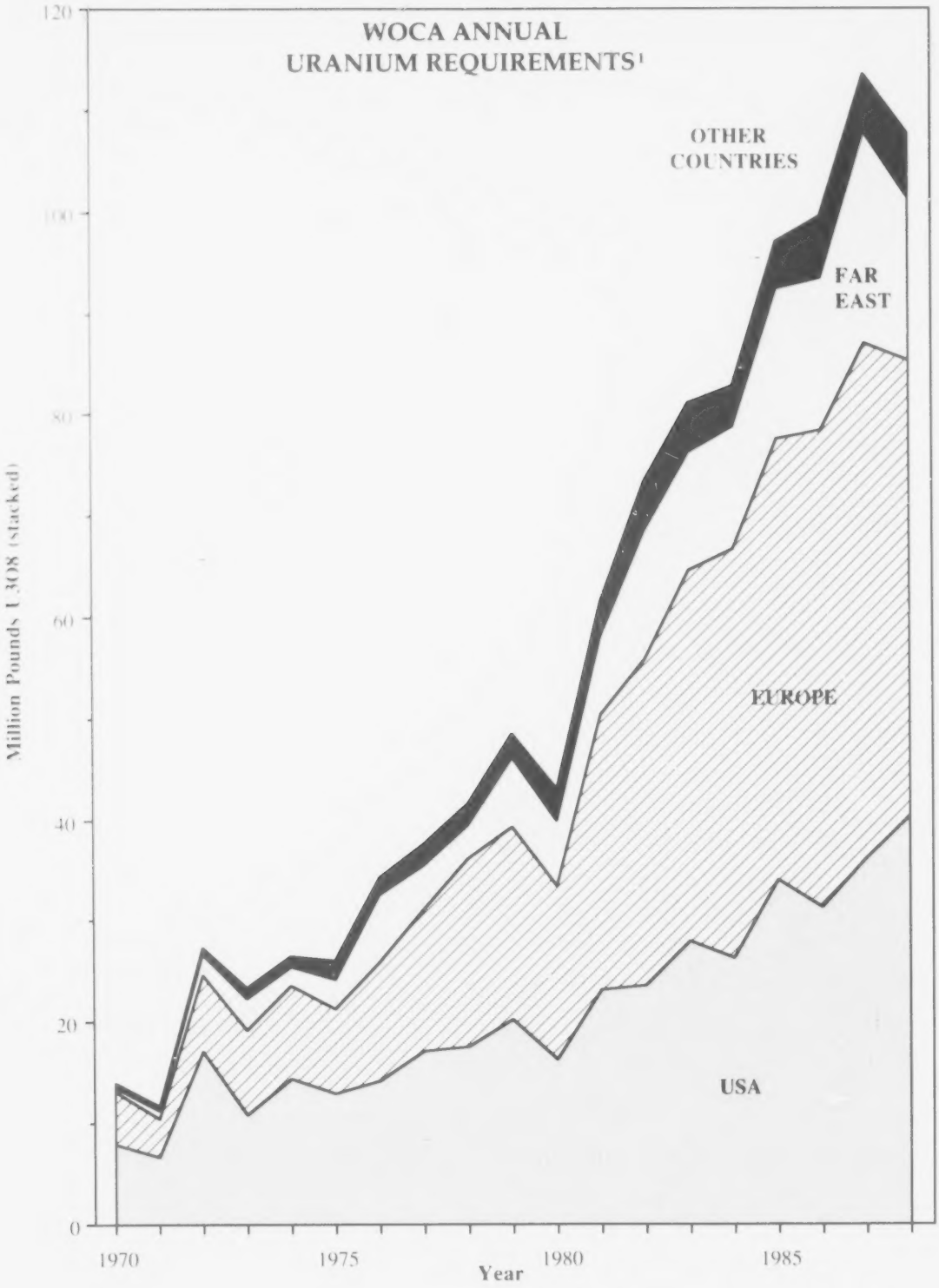
HISTORICAL MARKET DATA



1 WOCA = World Outside of Centrally-Planned Economic Areas.

2 Estimated world production in 1989 totalled 89.6 million pounds (Australia—9.5; Canada—28.7; France—8.5; Gabon—2.2; Namibia—9.2; Niger—7.7; South Africa—7.7; USA—13.7; Other—2.3).

© NUEXCO 1990



[1] Calculated by NUEXCO based on actual plant completion dates and operating performance, and NUEXCO's estimate of enriching tails assays.

© NUEXCO 1990

NUEXCO

HISTORICAL MARKET DATA

US URANIUM MARKETING ACTIVITIES STATISTICS
(Compiled from data published by the US Energy Information Administration) [1]

Year	Total Production (million pounds U_3O_8)	Deliveries to Domestic Utilities From US Suppliers[2] (million pounds U_3O_8)	Average Price of Delivered Uranium[2] ($/lb. U_3O_8)	Quantity of Uranium Imported[3] (million pounds U_3O_8)	Average Price of Imported Uranium ($/lb. U_3O_8)	Quantity of Uranium Exported (million pounds U_3O_8)
1976	25.5	27.6	16.10	3.6	n/a	1.2
1977	29.9	27.8	19.75	5.6	n/a	4.0
1978	37.0	31.6	21.60	5.2	n/a	6.8
1979	37.5	33.0	$23.85	3.0	n/a	6.2
1980	43.7	35.0	$28.15	3.6	$43.10	5.8
1981	38.5	32.6	$34.65	6.6	$32.90	4.4
1982	26.9	23.5	$38.37	17.1	$25.19	6.2
1983	21.2	24.2	$38.21	8.2	$26.16	3.3
1984	14.9	22.5	$32.65	12.5	$21.86	2.2
1985	11.3	21.7	$31.43	11.7	$20.08	5.3
1986	13.5	18.9	$30.01	13.5	$20.07	1.6
1987	13.0	20.8	$27.37	14.8	$19.14	1.0
1988	13.1	17.6	$25.65	15.8	$19.03	3.3

[1] Sources: 1976-1983: US Department of Energy/Energy Information Administration, *Survey of United States Marketing Activity*
1984-1988: Energy Information Administration, *Uranium Industry Annual*

[2] Data for 1976-1981 includes both domestic utilities and agents

[3] Includes imports by domestic utilities and domestic suppliers

© NUEXCO 1990

VOLUME AND PRICE OF URANIUM DELIVERIES TO THE EUROPEAN COMMUNITY[1]
(Compiled from data published by the Euratom Supply Agency)

Year	Volume of Deliveries to the EC[2] (in MTU)	Percentage of Deliveries Made Under Spot Contracts	Medium or Long-Term Contracts[3,4]		Spot Contracts[3,4]	
			Average Price in ECU per pound U$_3$O$_8$	Average Price in US Dollars per pound U$_3$O$_8$	Average Price in ECU per pound U$_3$O$_8$	Average Price in US Dollars per pound U$_3$O$_8$
1977	n/a	n/a	n/a	n/a	n/a	$41.00
1978	n/a	n/a	n/a	n/a	n/a	$43.00
1979	10,000	n/a	n/a	n/a	n/a	$44.50
1980	8,600	n/a	n/a	$36.00	n/a	$35.00
1981	13,000	less than 10	n/a	$33.25	n/a	$28.00
1982	12,500	less than 10	ECU 32.25	$32.00	ECU 24.25	$24.00
1983	13,500	less than 10	ECU 34.75	$31.00	ECU 26.00	$23.25
1984	11,000	less than 10	ECU 37.75	$29.75	ECU 24.50	$19.25
1985	11,000	11.5	ECU 38.00	$29.00	ECU 19.50	$15.00
1986	12,000	9.5	ECU 31.50	$31.00	ECU 18.00	$17.75
1987	14,000	17.0	ECU 28.25	$32.50	ECU 15.00	$17.25
1988	12,500	4.5	ECU 26.92	$31.82	ECU 13.65R	$16.13R

R = Revised

[1]The twelve European Community member nations are Belgium, Denmark, France, the Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom; prior to January 1986, Spain and Portugal were not members of the EEC.

[2]The only deliveries taken into account are those made to final users, namely the electric utilities or their procurement organizations; deliveries to middlemen or fuel cycle companies are not included. The sales between utilities in the Community are also excluded. The quantities covered are those which were entered into accounting records during the year stated.

[3]For deliveries made under medium or long-term contracts (i.e., for which the time between the date of signature and the date of the last delivery exceeds one year) the prices were expressed in several different currencies. In order to calculate an average price, these prices have been converted into European Currency Units (ECU) and US dollars. The average prices were weighted by quantity and converted on the basis of the average annual exchange rate of the different currencies against the ECU and US dollar.

[4]Exchange rates are published by European Communities Statistical Office and the International Monetary Fund.

© NUEXCO 1990

NUEXCO

GOVERNMENT STATISTICS

AUSTRALIA

		Consumer Price Index[1] (1980/1981 = 100)	Price Index of Materials Used in Manufacturing Industry — All Groups[2] (1984/1985 = 100)	Average Weekly Ordinary Time Earnings — Adult Males — Australia (Australian dollars)[6]	Award Rates of Pay Indexes Australia - Adult Males In Mining Wage Earners, Weekly Rates[3] (June 1985=100)
1980	Avg.	95.8	83.1	—	140.8[5]
1981	Avg.	105.0	85.9	—	154.1[5]
1982	Avg.	116.7	89.0	—	174.9[5]
1983	Avg.	128.5	96.9	—	181.9[5]
1984	Avg.	133.6	98.0	—	194.4[5]
1985	Avg.	142.6	107.3	—	103.7
1986	Avg.	155.5	101.5	—	106.1
1987	Avg.	168.7	108.9	465.88	112.3
1988	Avg.	180.9	111.8	496.90	115.2
Jan	1989	—	110.6	—	122.2
Feb	1989	—	111.2	521.90	122.2
Mar	1989	188.1R	114.9	—	123.1
Apr	1989	—	117.5	—	123.2
May	1989	—	118.6	530.40R	123.7
June	1989	192.8	119.9	—	124.7R
July	1989	—	120.1	—	125.8R
Aug	1989	—	119.2	539.30	125.9R
Sept	1989	197.2	117.7	—	125.9R
Oct	1989	—	117.8	—	126.0
Nov	1989	—	118.0	—	126.2

P = Preliminary R = Revised since last month

[1]Weighted average of six State capital cities (1975 to 1980), and eight capital cities from 1981 (Base: Financial year July 1980 to June 1981 =100.0). Figures shown at end of quarter represent quarterly average.
[2]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0).
[3]Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0). Figures for the latest fourteen months shown are subject to revision.
[4]Monthly data for the period 1967 to 1986 appear in Report 233.
[5]Base: June 1976 = 100.
[6]Australian Bureau of Statistics, Canberra: "Average Weekly Earnings, States & Australia" (Catalogue No. 6302.0).

© NUEXCO 1990

CANADA

		Industrial Products Price Index: All Commodities[1] (1981 = 100)	Consumer Price Index: All Items (1981 = 100)	Wage-earner Data: Average Hourly Earnings (C$)[2] Uranium Mines (SIC 057)	Metal Mines (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Metal Rolling, Casting and Extruding (SIC 298)	Chemicals and Chemical Products Industries (SIC 372-379)
1980	Avg.	90.7	88.9	—	—	—	—	—
1981	Avg.	100.0	100.0	—	—	—	—	—
1982	Avg.	106.7	110.8	—	—	—	—	—
1983	Avg.	110.4	117.2	17.22	—	14.18	10.67	11.10
1984	Avg.	115.4	122.3	17.89	—	14.97	11.11	11.68
1985	Avg.	118.6	127.2	18.53	16.48	15.56	11.85	12.12
1986	Avg.	119.6	132.4	19.38	16.70	15.76	12.28	12.58
1987	Avg.	122.7	138.2	20.12	17.15	16.11	12.58	13.20
1988	Avg.	128.1	143.8	20.91	18.51	16.95	13.17	13.77
Jan	1989	130.7	146.8	21.22	19.45	18.14	13.75	13.82
Feb	1989	130.8	147.8	22.05	19.51	18.26	13.79	13.89
Mar	1989	131.3	148.5	21.90	19.65	18.35	13.62	14.10
Apr	1989	131.3	149.0	22.37	19.80	18.40	13.57	14.16
May	1989	131.4	150.5	21.89	20.02	18.17	13.76	14.27
June	1989	131.5R	151.3	21.89	20.02	18.17	13.76	13.22
July	1989	131.4R	152.3	21.67	19.60	17.96	13.57	12.98
Aug	1989	131.3R	152.4	20.97	19.76	18.24	13.52	14.30
Sept	1989	131.0R	152.6	21.97	20.61	18.73	13.68	14.83
Oct	1989	130.8	153.2	22.26	20.71R	18.74R	13.99	14.77R
Nov	1989	130.6R	153.7	22.60P	20.52P	18.80P	13.93P	14.65P
Dec	1989	130.2	153.6	—	—	—	—	—

P = Preliminary **R** = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011). Indexes for the most recent six months shown are subject to revision. This category was formerly known as "Manufacturing." Monthly data for the period 1967 to 1986 is found in Report 233.

[2]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours." Monthly data for the period 1983 to 1986 is found in Report 233.

[3]Reports 175 through 185 list this series title incorrectly as "Metal Mining, Including Milling (SIC 050-099)."

© NUEXCO 1990

NUEXCO

GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

		Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982 = 100)[2]	Consumer Price Index[3] (1985 = 100)	Production Price Index All Groups[4] (1985 = 100)	Total Employment in Mining and Quarrying[5]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand)[5]
1980	Avg.	35.53	—	51.9	55.2R	709,042	2,237,689
1981	Avg.	41.89	—	59.8	62.7R	722,918	2,756,928
1982	Avg.	47.25	104.2	68.6	71.4R	702,041	3,181,584
1983	Avg.	51.88	115.0	77.1	79.0R	700,901	3,563,282
1984	Avg.	58.95	130.3	86.0	85.6R	711,511	4,134,390
1985	Avg.	68.76	151.6	100.0	100.0R	724,587	4,778,612
1986	Avg.	80.22	177.9	118.6	119.5R	756,637	5,767,950
1987	Avg.	95.01	223.1	137.7	136.2R	751,864	6,911,395
1988	Avg.	106.69	241.1	155.4	154.1R	705,355	7,774,054
Jan	1989	—	—	166.8	165.5R	714,593	704,320
Feb	1989	—	—	168.2	168.5R	696,329	669,983
Mar	1989	112.29	262.8	170.9	171.1R	702,746	695,843
Apr	1989	—	—	173.1	173.8R	658,677	634,344
May	1989	—	—	175.9	176.4R	706,056	721,263
June	1989	113.76	267.0	177.7	177.1R	706,810	720,586
July	1989	—	—	179.3	178.8R	711,648	775,002
Aug	1989	—	—	181.8	180.7R	703,812	793,475
Sept	1989	119.76	280.2	183.4	181.7R	—P	—
Oct	1989	—	—	185.1	183.9R	—	—
Nov	1989	—	—	187.0	185.6	—	—

P = Preliminary R = Revised since last month

[1]Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly. Historical Data by month appears in Report 236.
[2]Page 16 of Report 178 contains description and calculation of index, and page 24 of Report 178 lists figures for 1982.
[3]Central Statistical Service, Pretoria: All income groups-weighted average, Historical Data by month appears in Report 236.
[4]Central Statistical Service, Pretoria: All commodities for consumption in South Africa.
[5]Central Statistical Service, Pretoria: Historical Data by month appears in Report 236.

© NUEXCO 1990

UNITED STATES

		Producer Price Index[1]		Consumer Price	GNP Implicit Price	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
		Industrial Commodities (1982 = 100)	All Commodities (1982 = 100)	Index[2] (1982-1984 = 100)	Deflator[3] (1982 = 100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1980	Avg.	88.0	89.8	82.4	85.7	10.26	10.63	8.30	6.94
1981	Avg.	97.4	98.0	90.9	94.0	11.55	11.98	9.12	7.62
1982	Avg.	100.0	100.0	96.5	100.0	12.31	12.93	9.96	8.21
1983	Avg.	101.1	101.3	99.6	103.9	12.58	13.43	10.58	8.67
1984	Avg.	103.3	103.7	103.9	107.7	13.05	13.43	11.07	9.04
1985	Avg.	103.7	103.2	107.6	110.9	13.38	13.74	11.56	9.46
1986	Avg.	100.0	100.2	109.6	113.9	12.46	13.48	11.98	9.65
1987	Avg.	102.6	102.8	113.6	117.7	12.52	12.98	12.37	9.88
1988	Avg.	106.3	106.9	118.3	121.7	13.09	13.22	12.67	10.13
Jan	1989	109.4	110.5	121.1	—	13.80	13.49	12.85	10.27
Feb	1989	110.1	110.8	121.6	—	13.66	13.48	12.88	10.26
Mar	1989	110.5	111.5	122.3	125.4	13.71	13.51	12.91	10.30
Apr	1989	111.8	112.3	123.1	—	13.68	13.65	12.92	10.31
May	1989	112.1	113.2	123.8	—	13.60	13.57	12.98	10.33
June	1989	112.4	112.9	124.1	126.0	13.62	13.66	12.98	10.37
July	1989	112.2	112.8	124.4	—	13.70	13.75	13.12	10.41
Aug	1989	111.4	112.0	124.6	—	13.64	13.72	13.08	10.40
Sept	1989	111.9	112.3	125.0	126.8	13.70	13.99	13.18	10.47
Oct	1989	112.4	112.7	125.6	—	13.76R	13.94R	13.25R	10.43R
Nov	1989	112.2	112.7	125.9	—	13.66P	14.12P	13.26R	10.47R
Dec	1989	112.3	113.0	126.1	128.0	—	—	13.28P	10.52P

P = Preliminary **R** = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.: "Producer Prices and Price Indexes," (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents. Historical data is presented in Report 233.

[2]US Bureau of Labor Statistics, Washington, D.C.: Consumer Price Index for All Urban Consumers, US City Average, All Items. Historical data is presented in Report 233.

[3]US Department of Commerce, Washington, D.C.: Bureau of Economic Analysis, National Income and Wealth Division: "Survey of Current Business." The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted. Historical data is presented in Report 233.

[4]US Bureau of Labor Statistics, Washington, D.C.: "Employment and Earnings." All data based on 1972 revision of SIC Manual. Historical data is presented in Report 233.

© NUEXCO 1990

NUEXCO

INTERNATIONAL ADVISORY COMMITTEE

J. Robert (Bob) Wolcott
Chairman
USA

* * *

T.J. (Tom) Barendregt
The Netherlands

O.J.C. (John) Runnalls
Canada

George J. Stathakis
USA

W. Bryan Webster
USA

Chris I. von Christierson
South Africa

Lars Halle
Sweden

James C.C. Stewart
United Kingdom

REPRESENTATIVES

AUSTRALIA:

James G. Munro
7 Nevada Street
North Balwyn, Victoria 3104
Australia
Telephone: (61-3) 857-6823
Telecopy: (61-3) 857-8258

JAPAN:

Kazuo Yokota
Japan Tech Services
Ohkura Building (3F)
1–4–10 Shiba Daimon
Minato-ku, Tokyo, Japan
Telephone: (81-3) 431-6031, 6025
Telecopy: (81-3) 434-6674
Telex: 242-5060 (JATECH J)

SOUTH AFRICA:

Chris I. Von Christierson
Southern Prospecting (Pty) Limited
Mailing Address:
Post Office Box 61409
Marshalltown 2107
Republic of South Africa
Street Address:
7th Floor, Marshall Place
66 Marshall Street
Johannesburg 2001
Telephone: (27-11) 834-4211
Telecopy: (27-11) 834-6343
Telex: 4-89878-SA

TAIWAN:

Dr. Steve H.K. Wang
Southeast Engineering Corporation
Yu-Ming Mansion
7, Roosevelt Rd., Sec. 1, 7th Floor
Taipei, 10757, Taiwan R.O.C.
Telephone: (886-2) 321-0216
Telecopy: (886-2) 394-2621
Telex: 11285 (SENCORP)

UNITED STATES:

Harold C. Lindberg
83-A Hardee Lane
Whispering Pines, North Carolina 28327
Telephone: (919) 949-3622
Telecopy: (919) 949-2626

Ralph O. Smith
141 Braemar Drive
Cheshire, Connecticut 06410
Telephone: (203) 272-6246
Telecopy: (203) 271-1346

© NUEXCO 1990

INTERNATIONAL HEADQUARTERS

Three Park Central, Suite 900
1515 Arapahoe Street
Denver, Colorado 80202

Telephone: (303) 899-4500
Telecopy: (303) 899-4555
Telex: 450202/NUEXCO